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Foreword

The UNITED STATES ARMED FORCES MEDICAL JOURNAL represents the unification of the BULLETIN OF THE UNITED STATES ARMY MEDICAL DEPARTMENT and the UNITED STATES NAVAL MEDICAL BULLETIN. This joint periodical is the medium for disseminating information of administrative and professional interest to all medical personnel of the Department of Defense.

The Chairman of the Armed Forces Medical Policy Council and the Surgeons General of the several services invite all medical officers, dental officers, Medical Service Corps officers, Nurse Corps officers, and officers of the Veterinary Corps of the Armed Forces, and the medical consultants of the Army, Navy, and Air Force to submit manuscripts for publication in this JOURNAL.

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OFFICE OF THE SECRETARY OF DEFENSE
ARMED FORCES MEDICAL POLICY COUNCIL
WASHINGTON 25, D.C.

MEMO: Personnel of the Medical Services of the United States Armed Forces

The care of the wounded in any battle zone is one of the major responsibilities of the military surgeon. Even though the wounded must be treated under the most adverse physical conditions, the accepted principles of surgical policies and procedures must be preserved and maintained at all times.

The Department of the Army has recently published a treatise on the management of battle casualties in its technical bulletin, TB-MED 147. Attention to the general principles and procedures in this bulletin will result in improved care of the wounded.

In view of a recent report of an Army research team for medical investigation in the field, particular attention is invited to the section on craniocerebral wounds, abdominal wounds, and the principle of primary debridement with secondary closure of wounds several days later.

Rehabilitation of the wounded returning from Korea is being followed with interest and to date the results of the care of the wounded have been excellent.

W. Randolph Lovelace II

W. Randolph Lovelace, II, M. D.
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Streptokinase and Streptodornase in the Treatment of Pilonidal Cysts

Joseph M. Miller, *Major, MC, U. S. A. R.* (1)
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Perrin H. Long, *Colonel, MC, U. S. A. R.* (2)

THE number of man-days lost in the Army during World War II as a result of pilonidal cyst and its complications is estimated at about 3,470,000 (3). The treatment of this disease has been remarkable for the wide variation of methods used and poor results obtained. Delayed healing and recurrence are the primary problems still to be solved. A cyst which is not infected is treated best by excision and primary closure, and the results in this type were good toward the end of the war. A pilonidal cyst which is associated with gross infection or abscess presents a more difficult problem because the infection must be controlled before a curative operation can be undertaken. Since ambulatory treatment in the Armed Forces is impossible, patients with infected pilonidal cysts must be hospitalized. Because patients must be kept until maximum hospital benefit is attained, time lost from duty by such patients has been from 60 to 90 days. This loss of time became so great during the war that abscesses were incised and drained, the patient returned to duty and a definitive operation postponed indefinitely. In the present mobilization large numbers of men with pilonidal cysts and potential pilonidal abscesses will be inducted. The clinical experiences of Tillett and his associates (4-7)

(1) Veterans Administration Hospital, Fort Howard, Md.
(2) Department of Preventive Medicine, Johns Hopkins University School of Medicine, Baltimore, Md.
(3) Figure furnished by Statistical Division, Office of the Surgeon General, U. S. Army.
(4) Tillett, W. S.; Sherry, S.; and Christensen, L. R.: Streptococcal desoxyribonuclease; significance in lysis of purulent exudates and production by strains of hemolytic streptococci. Proc. Soc. Exper. Biol. & Med. 68: 184-188, May 1949.
(5) Tillett, W. S.; Sherry, S.; Christensen, L. R.; Johnson, A. J.; and Hazelhurst, G.: Streptococcal enzymatic débridement. Ann. Surg. 131: 12-22, Jan. 1950.

with streptokinase and streptodornase in the treatment of infected wounds has permitted a more rapid preparation of pilonidal cysts with abscess for curative operations. Streptokinase and streptodornase will effect changes in a grossly infected wound to make it one which is amenable to a curative operation. A more complete report on the action and the methods of application of these compounds will be found elsewhere (8).

These biologic compounds are not only efficacious in the preoperative period but may be used to advantage after operation. Short segments of ureteral catheters or polythene tubing may be placed laterally to the wound down to the deep fascia over the coccyx. Absolute hemostasis is difficult to achieve in an area which has been the recent seat of an inflammation. The accumulation of small amounts of blood beneath the skin flaps encourages infection because blood is an ideal culture medium. The catheters afford a method to place streptokinase and streptodornase into the wound postoperatively to eliminate factors which permit infection. Streptokinase, by causing fibrinolysis will allow a more satisfactory evacuation of clotted blood. Air vent suction through the catheters will remove accumulations of blood or the products of enzymatic action and permit apposition of the skin flaps to the base of the wound.

CASE REPORTS

Case 1. A 25-year-old man was admitted to the Veterans Administration Hospital, Fort Howard, Md., on 12 June 1950 with a history of having repeated episodes of infection in a pilonidal cyst for about 3 years. A pilonidal cyst, with sinuses from which purulent material drained, was present. An incision was made and a means of drainage provided on 14 June when a small amount of purulent material was released from the wound. *Staphylococcus albus* and diphtheroids were isolated from the wound; 100,000 units of aqueous crystalline penicillin G were given intramuscularly every 3 hours on 17 June but this was discontinued because of a questionable allergic reaction. One gram of sulfadiazine was given orally every 6 hours from 19 June through 28 June and 30,000 units of streptokinase and 20,000 units of streptodornase were applied topically to the wound 3 times between 16 June and 18 June. An excision of the pilonidal cyst and a primary closure were performed on 19 June, 5 days after incision for drainage. The postoperative course was smooth and the patient was discharged from the hospital on 30 June.

(6) Sherry, S.; Tillett, W. S. and Christensen, L. R.: Presence and significance of desoxyribose nucleoprotein in the purulent pleural exudates of patients. Proc. Soc. Exper. Biol. & Med. 68: 179-184 May 1949.

(7) Tillett, W. S., and Sherry, S.: The effect in patients of streptococcal fibrinolysin (streptokinase) and streptococcal desoxyribonuclease on fibrinous, purulent and sanguineous pleural exudations. J. Clin Investigation 28: 173-190, Jan. 1949.

(8) Miller, J. M.; Ginsberg, J.; Lipin, R. J.; and Long, P. H.: Clinical experience with streptokinase and streptodornase. J. A. M. A. 145: 620-624, Mar. 3, 1951.

Case 2. A 25-year-old man was admitted to the Veterans Administration Hospital on 3 July 1950 with an abscess in a pilonidal cyst. An incision for drainage had been made elsewhere in 1945. Pain and swelling had been present before this admission for about 4 days. From 3 July through 16 July, 50,000 units of aqueous crystalline penicillin G were given intramuscularly every 3 hours. The dose of penicillin was increased to 100,000 units from 17 July through 25 July and 1.5 grams of gantrisin were given orally 4 times a day from 17 July through 20 July. At the time of operation on 5 July about 30 cc. of purulent material were released from the abscess. A hemolytic *Staphylococcus aureus* was cultured from the wound and 50,000 units of streptokinase and 75,000 units of streptodornase were applied topically to the wound 4 times between 7 July and 14 July. Forty thousand units of streptokinase and 60,000 units of streptodornase were applied on 16 July. Excision and primary closure were performed on 17 July. Postoperatively the wound healed well. The patient was discharged from the hospital on 28 July.

Case 3. A 25-year-old man was admitted to the Veterans Administration Hospital on 6 August 1950 with an abscess of 3 weeks' duration in a pilonidal cyst. An incision for drainage was provided on 7 August when about 30 cc. of malodorous purulent material were evacuated from the wound. A *Streptococcus anaerobius* was cultured from the purulent material, 50,000 units of streptokinase and 75,000 units of streptodornase were applied topically to the wound 4 times between 8 August and 14 August. An excision of the pilonidal cyst and a primary closure were performed on 15 August. The wound was well healed when the patient was discharged from the hospital on 29 August.

Case 4. A 31-year-old man was admitted to the Veterans Administration Hospital on 28 August 1950 with an abscess in a pilonidal cyst present for about 10 days. An area of induration about 5 cm. in diameter was present over the sacrum. The patient had had numerous episodes of infection in the preceding 9 years. From 29 August through 3 September, 300,000 units of aqueous crystalline penicillin G were given once a day. The same dose of penicillin was given twice a day from 5 September through 8 September then once a day through 11 September. An incision for drainage of the abscess was made on 29 August. A micro-aerophilic gamma streptococcus was isolated from the wound; 50,000 units of streptokinase and 23,750 units of streptodornase were applied topically to the wound on 30 August and 31 August; 20,000 units of streptokinase and 9,500 units of streptodornase were applied on 5 September. A small piece of ureteral catheter was inserted through each buttock into the wound and these catheters were removed on 8 September. The wound was well healed on 15 September and the patient was discharged from the hospital on 19 September.

Case 5. A 28-year-old man was admitted to the Veterans Administration Hospital on 4 October 1950 with a history of repeated episodes of pain and tenderness in the coccygeal region. About 3 days before admission the area became tender, red, and swollen (fig. 1). An incision for drainage was performed on 6 October and 10 cc. of purulent material obtained. *Streptococcus faecalis* was isolated on culture from the wound; 300,000 units of aqueous crystalline penicillin G were given intramuscularly daily and continued to 3 November; 100,000 units of streptokinase and 150,000 units of streptodornase were applied topically to the wound daily 8 times between 7 October and 14 October

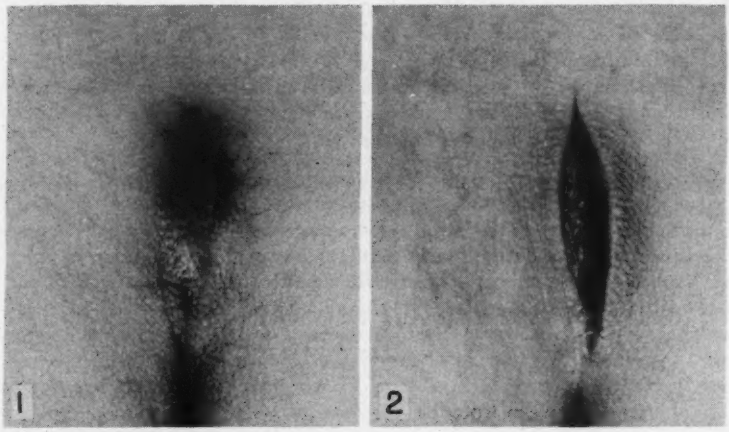
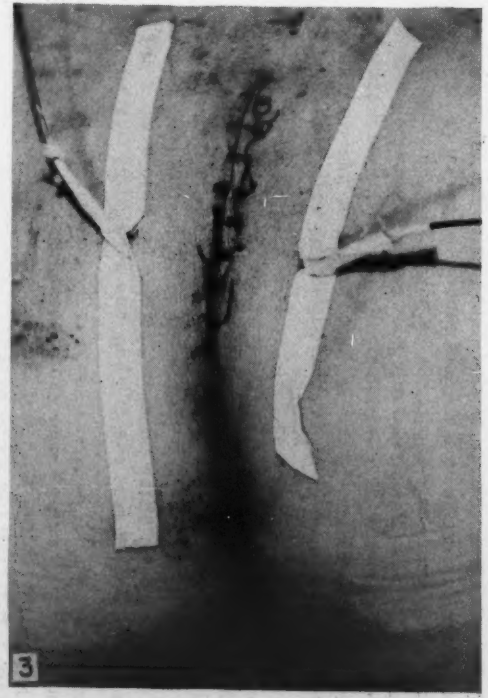


Figure 1. (6 October). Abscess in pilonidal cyst. Figure 2. (9 October). Wound after incision and treatment with streptokinase and streptodornase for 2 days.

(fig. 2). An excision of the pilonidal sinus and a primary closure was performed on 16 October with ureteral catheter drainage (fig, 3). The ureteral catheters were removed on 21 October. There was minimal localized skin infection in the region of the lower two skin sutures (fig. 4) which rapidly cleared and the incision was well healed on 3 November.

Case 6. A 25-year-old man was admitted to the Veterans Administration Hospital on 17 January 1951 with an infected pilonidal cyst. The abscess was incised on the same day and about 30 cc. of purulent material were released from the area. *Aerobacter aerogenes* was isolated from the purulent material; 300,000 units of aqueous crystalline procaine penicillin G were given intramuscularly daily from 17 January through 26 January and from 27 January through 2 February; 25,000 units of streptokinase and 12,000 units of streptodornase were applied topically to the wound from 18 January through 28 January. An excision of the pilonidal sinus and a primary closure were performed



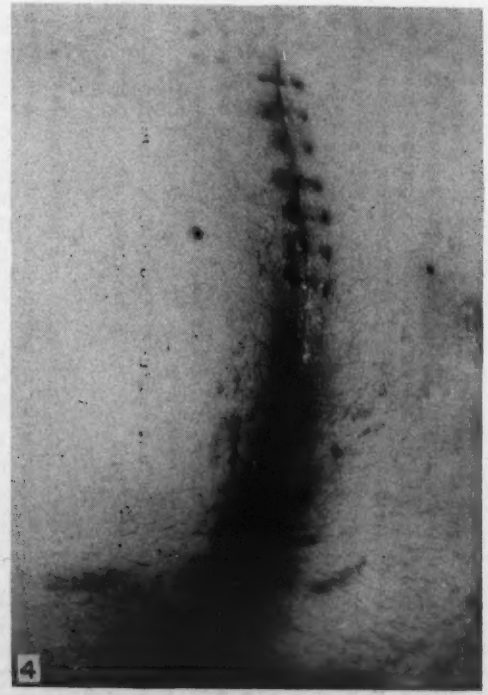


Figure 3. (17 October). Area of operation on fourth postoperative day. Note polythene tubing placed bilaterally. Figure 4. (31 October). Incision almost completely healed.

on 29 January. An infection around one of the sutures was noted on 6 February and a slight amount of purulent drainage was found on 7 February. The wound, otherwise, healed well. The patient was discharged on 15 February.

DISCUSSION

Sixteen patients with abscessed pilonidal cyst have been treated by incision, drainage, and the topical application of streptokinase and streptodornase in preparation for excision. Catheters were not used during the treatment of the patients treated early in this series but are now inserted routinely. Primary healing was achieved in 11 of the 16 patients. The average time spent in the hospital was about 33.7 days. The routine use of catheters in the wound at the time of the curative operation will lower this figure. One patient returned with a small area of infection which rapidly responded to incision and the topical application of streptokinase and streptodornase. A recurrence of the pilonidal cyst has not been seen in any of these patients, but it must be remembered that the first patient treated with the routine outlined was seen on 15 March 1950 and that a recurrence may be seen in the future.

The figure of 33.7 days can be lowered in civilian hospitals where patients may be released earlier to convalesce in their homes. In the Armed Forces, patients must be able to return to full-duty status and must be retained in the hospital until the wound is completely healed; 33.7 days, however, stands in sharp contrast to the 60 to 90 days usually lost by patients in the Armed Forces treated by earlier methods. The recurrence rate should not be any higher using the method suggested because this method only adds the use of streptokinase and streptodornase and air vent suction to previously accepted procedures. Many of the principles applied in the treatment of infected pilonidal cysts will be applicable in uninfected patients as well.

A comparable series of 17 patients with infected pilonidal cysts which required incision and provision of a means of drainage before excision in the period before streptokinase and streptodornase were available for use was analyzed. Primary healing was achieved in 14 of the 17 patients. The average time spent in the hospital was about 46 days. A recurrence of the pilonidal cyst has not been seen in any of these patients, the first one of whom was seen on 29 October 1946.

An average of 12.3 days was saved in the hospital time of each patient treated with streptokinase and streptodornase. This saving would be particularly important in the Armed Forces. The money saved at current hospital rates is appreciable.

SUMMARY

Grossly infected pilonidal cysts or those associated with abscess pose a particularly difficult problem in treatment, because the duration

of sucn treatment is usually lengthy. The introduction of streptokinase and streptodornase afford the surgeon a new method of treatment to prepare infected wounds for curative operation. Air vent suction provided by catheters offers an additional way to facilitate healing. Streptokinase and streptodornase may be introduced into the wound postoperatively by the catheters and the products of digestion of fibrin and desoxyribose nucleoprotein removed.

Thoracic Injuries in World War II

III. The Surgical Treatment of Traumatic Lesions of the Intrathoracic Cardiovascular Structures (1)

Herbert D. Adams, *Commander, MC, U. S. N. R.* (2)

WOUNDS of the thorax, either major or minor, whether caused by fragments, bullets, bayonets, or knives, have the serious potentiality of an injury to one of the many vascular structures of the thorax, both superficially and deeply located in the thorax. It is difficult to estimate the incidence of this type of war injury because most of these wounds were undoubtedly immediately fatal. This is because a tourniquet or pressure control was not possible in most of these vascular injuries. This type of injury, however, was not always fatal because some of these patients reached base hospitals at great distances for definitive treatment. The hemorrhage was at least temporarily controlled by certain limiting anatomic structures and by the hematoma and infiltration of the surrounding muscles and tissues. The diagnosis was frequently missed because of the insignificance of the external wound or because of the lack of obvious extensive infiltration, hematoma, visible or palpable pulsation, or other significant physical findings. In many cases diagnosis was not made until an episode of serious secondary hemorrhage occurred. It became absolutely essential that every wound in this region be examined specifically for evidence of arterial or vascular injury, especially by auscultation for the presence of a bruit and by roentgenologic examination for intrathoracic injury of vascular structures.

Because of the serious nature of the operation necessary to cure this type of injury, surgical treatment was withheld long enough to insure a reasonably certain diagnosis, ruling out bruits resulting from extrinsic infiltration and pressure on an artery or vascular structures,

(1) Part I, General Considerations, Alterations of Pulmonary Physiology, and Therapy in the Initial and Reparative Stages, by Howard K. Gray, Captain, MC, U. S. N. R., and James D. Fryfogle, M. D., appeared in the August issue; and Part II, Therapy in the Reconstructive Phase, by Joseph P. O'Connor, Commander, MC, U. S. N. R., appeared in the September issue of this journal.

(2) Lahey Clinic, Boston, Mass.

and also functional bruits. Operation should be performed as promptly as possible, however, to avoid serious secondary hemorrhages, pressure on adjacent structures, or a serious disturbance of the intrathoracic dynamics. Because no specific first-aid measures were effective in this type of injury, supportive measures were necessary to maintain the patient long enough to reach hospitals equipped for major thoracic surgical procedures. These injuries should receive priority above all other types of injury.

CARDIAC INJURY

Penetrating wounds of the thorax with laceration of the heart produce massive intrapericardial hemorrhage and associated tamponade. In a small percent of these patients, especially when there was only a laceration of the cardiac wall without penetration into the cardiac chambers, the intrapericardial hemorrhage did not produce an immediate lethal tamponade and the increasing intrapericardial pressure tended to control the hemorrhage from the cardiac musculature. Likewise, a small missile passing into or through one of the chambers could also, at least temporarily, produce a balanced tamponade without immediate complete cardiac embarrassment. Under these conditions a certain small percent of patients with this type of injury reached adequate operative facilities where the pericardium could be opened widely, the lacerations of the heart sutured, and the pericardium drained. It was not feasible to perform a temporary decompression of the pericardium in this type of injury as it was in patients with tension hemothorax or pneumothorax.

Because patients with tension hemopericardium can survive only a few hours at the most, the diagnosis must be made at once and established by the characteristic clinical findings of cardiac tamponade. This is characterized by profound cardiovascular and respiratory disturbance as evidenced by dyspnea, ashen cyanosis, and shock accompanied by an extremely weak, thready pulse, greatly lowered pulse pressure, increased venous pressure, and distant muffled, weak cardiac sounds on auscultation. Because these patients will not tolerate even a moderate degree of cardiac compression for long, it is imperative that they be operated on by a left peristernal approach, the pericardium opened and the hemorrhage from the cardiac wall or cardiac chamber controlled by carefully placed silk or cotton sutures. It is important to avoid the pleura because any pulmonary collapse might prove to be a serious factor in an already critical cardiorespiratory balance. If the pleura is inadvertently opened, closed drainage, or preferably suction drainage of the pleural space is imperative to facilitate as rapid re-expansion of the lung as possible. Likewise, the pericardium should also always be drained and in all of these injuries massive doses of penicillin should be given intramuscularly.

INTRACARDIAC FOREIGN BODIES

Intracardiac fragments lying freely within a cardiac chamber, whether washed there in the blood stream, having entered the vascular system at some distance from the heart, or whether they have penetrated directly through the cardiac wall and lie freely in a cardiac chamber, should also be removed. Because the patient is usually in severe shock, the added manipulation and loss of blood entailed in the removal of such a fragment from a cardiac chamber must be put off until the patient has wholly recovered from his initial loss of blood and cardiac tamponade, but, when his condition permits, either as a primary or a secondary operation after cardiac suture, the pericardium is opened, and a proper exposure of the chamber in question is obtained. Blood by transfusion should be flowing through at least two large-caliber needles into every patient with major cardiovascular injury while he is undergoing any type of operation for relief of the injury. With the patient fully controlled in this manner, a purse-string suture is laid in the wall of the chamber in question and a circle of mattress sutures also taken into the wall for the control of that particular area during the probing for the fragment and the closure of the opening through the cardiac wall after its removal. An incision is then quickly made through the wall in the center of these controlling sutures and a heavy pair of forceps passed into the cardiac chamber, simultaneously tightening the purse-string suture and applying tension to the surrounding mattress sutures to control the blood loss around the probing instrument. The fragment is located by a bimanual maneuver and removed, the cardiac wall sutured, and the pericardium drained. It is likewise advisable, as soon as the patient's condition will permit, to remove fragments imbedded in the pericardium, or free in the pericardium, or imbedded in, or in contact with, the wall of the aorta, pulmonary artery, superior vena cava, subclavian, or innominate or proximal carotids, because of the great danger of erosion and serious secondary hemorrhage, or the development of an aneurysm.

INJURY TO MAMMARY AND INTERCOSTAL VESSELS

Although it is a well-established fact that hemothorax should be treated by aspiration in its early phases, it must be kept constantly in mind that such an intrapleural hemorrhage may be arising from a laceration of the mammary or intercostal arteries, or one of the hilar arteries, which will require early operation in order to prevent death. Injuries to the mammary and intercostal arteries were of two general types: (1) false aneurysms with subpleural hematoma infiltration and delayed external secondary hemorrhage, and (2) those associated with intrapleural laceration and continued intrapleural hemorrhage. This latter injury produced symptoms and signs of an increasing intrapleural pressure and mediastinal shift which progressed until death ensued in spite of oxygen therapy and thoracentesis unless the hilar artery

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was ligated. This is in direct contrast to hemothorax resulting from injury to the lung, which was usually controlled by the pulmonary tamponade from the associated hemothorax.

Physical signs of uncontrollable, progressive, intrapleural, tension hemothorax demand immediate exploration of the wound and a careful search for a lacerated mammary or intercostal artery, or, if this is found not to be the source of such progressive hemothorax, then the thorax must be opened widely and the hilar structures exposed and inspected for a laceration of a major hilar pulmonary artery or vein. Such a vessel would necessarily require ligation regardless of the possibility of subsequent pulmonary damage although permanent pulmonary damage would be unlikely by such a ligation. Whenever a thorax is opened widely in this early phase, it is, of course, necessary that the thorax be drained by a closed method, preferably suction, in order quickly to re-establish normal dynamics and re-expansion of the lung.

INJURY TO VASCULAR STRUCTURES IN THE MEDIASTINUM

Injuries to the mediastinal vascular structures were quite common and in most instances, if death did not occur at once from massive hemorrhage, the hemorrhage was at least temporarily controlled by infiltration of the surrounding tissues with a resulting pulsating hematoma or false aneurysm.

INJURY TO SUBCLAVIAN VESSELS

Injuries to the subclavian arteries were similar in many ways and in diagnostic findings to the injuries of other systemic arteries, but being more deeply situated, the external infiltration and hematoma were much less obvious and the diagnosis was made chiefly by the presence of a bruit and a widened mediastinum as evidenced by the roentgenogram. This was a rough bruit throughout systole or during the entire cardiac cycle if combined with an arteriovenous aneurysm. It was a common finding to have not only a false aneurysm but an arteriovenous aneurysm as well. This added complication of the arterial injury could often be diagnosed by an increased venous pressure in the arm involved and by venograms showing a distortion or block of the vein at the level of the injury.

Functional bruits were fairly common in this region and had to be distinguished carefully. This could be done by examining the patient frequently. The functional bruit varies considerably from examination to examination and in relation to the position of the patient and the position of the upper extremity. Likewise, simple compression from external pressure and infiltration about the artery may produce a bruit. It is again essential to distinguish, if possible, between compression and true laceration of a vessel with a false sac in which surgical treatment is essential to effect a cure. If there is any question regarding the diagnosis of the type of bruit heard, that is, whether it is caused by a false aneurysm or by a combination with an arteriovenous aneurysm,

or whether it is caused by external pressure, or whether it is a functional bruit, it is usually safe to keep the patient in bed under observation. As long as there are no signs or symptoms of further infiltration or cardiac damage, a period of close observation is justifiable. The functional bruits can be ruled out by their inconstant nature; the bruits caused by pressure gradually decrease in intensity as the roentgenologic signs of infiltration diminish and the patient improves.

Although the false aneurysms and arteriovenous aneurysms of the subclavian artery were the most hazardous surgical problems, the same general principles of management for all of the major vascular injuries were observed. In order to perform this type of operation it is essential to have a fully-equipped operating room, a trained anesthetist, adequate assistance, and continuous infusions throughout the procedure. It is found best to start the operation by tying large cannulas in the ankle veins of both legs so that if one should plug up at a crucial time in the operation the other could carry on satisfactorily. If a severe hemorrhage should be encountered, blood could be run through both as rapidly as possible.

The general principle of approach to this type of injury was to avoid entering the false aneurysm at any point before the major artery and vein, both proximal and distal to the injury, and all significant branches entering into this section of the injured vessel were fully controlled. This was accomplished by complete and accurate exposure of these vessels proximal and distal to the infiltrated site of the false aneurysm, and by control of the flow through these vessels by tension on small, soft catheters placed around the vessels. The vessels were then further exposed until finally the false aneurysmal sac was entered and the injury in the artery visualized. Even with full control of the injured major artery and vein, both proximal and distal to this site, and of all major branches entering this site, there was still a rapid flow of blood from the injured part into the sac. The artery and vein were then ligated carefully, both distal and proximal to the injury, and the injured part was excised, carefully preserving for collateral circulation all branches that did not immediately enter into the tissue to be excised.

In general, quadruple ligation and excision of the injured section of artery and vein is the procedure of choice from the standpoint of the greatest safety and curability. This more radical management was usually necessary owing to the extensive damage to the vessels and surrounding tissues, making repair or anastomosis of the artery hazardous because of potential secondary hemorrhage or recurrence of the false aneurysm. In early cases and those in which reasonably normal tissues are encountered, however, arterial reconstruction or excision and end-to-end anastomosis, if accomplished without undue tension, are the best methods of management. Great care and judgment must be exercised in deciding and applying these procedures.

To approach the subclavian vessels, a low cervical incision was made above the medial end of the clavicle. The lateral clavicular insertions of the sternomastoid muscle were cut and the carotid sheath and its contents retracted medially. The scalenus anticus muscle was exposed and the phrenic nerve freed and retracted medially. The scalenus muscle was then cut across and the subclavian artery exposed and a catheter passed around it for tourniquet action. Connecting with the original incision, a diagonal incision was then made across the pectoral region similar to that for axillary exposure except that the pectoral muscles were split for the exposure of the axillary vessels immediately below the clavicle, and catheters passed around them for control. The clavicle was then cut across and the ends retracted, widely exposing the injured part of the subclavian vessels. Dissection of these vessels was carefully carried out in both directions until the neck of the sac and false aneurysm were isolated and entered. Here again, considerable bleeding was accepted in the final identification of the opening in the artery. The artery and vein were ligated proximal and distal to the laceration and the injured part excised. Because the brachial cords were closely associated with the aneurysmal sac, the missile had often done direct damage to these nerves and further damage could be demonstrated from the direct pressure on and infiltration of these trunks from the dissecting hematoma and false aneurysmal sac. It was necessary to isolate them carefully and produce no operative trauma to these cords, but no attempt was made to suture any of the cords that were found injured at this time. The clavicle was then wired together and the wound closed, draining the wound with simple Penrose drains.

INJURY TO THE INNOMINATE ARTERY

False aneurysms and arteriovenous aneurysms involving the innominate artery and innominate vein and the left subclavian and left common carotid vessels within the superior mediastinum were diagnosed primarily on the basis of a bruit and the roentgenologic findings of infiltration of the superior mediastinum as well as induration extending into the suprasternal notch and the back of the neck.

Submanubrial and cervical pain were the outstanding symptoms. Again, because of the grave nature of the operation, it was necessary to be certain that this bruit was not caused by some external infiltration and pressure on the artery. As long as the patient was kept in bed under close observation and there were no signs of cardiac hypertrophy or change, the surgical procedure could be delayed to establish beyond question the presence of a false aneurysm. Several patients were observed in whom the roentgenologic signs of mediastinal infiltration and the bruit disappeared after weeks of observation. Continued pain, however, especially with exacerbations of pain, and increasing or undiminished bruit, or any signs of cardiac effects, made

surgical intervention imperative. The same general approach was essential for this type of operation. Because of the extremely close relationship of the vessels in the superior mediastinum and the base of the neck, it became much more difficult to avoid entering the false aneurysmal sac before adequate exposure and complete control of the injured vessel, both proximally and distally, were obtained.

A transverse incision was made across the midpart of the neck above the clavicles and the suprasternal notch which was then joined with a vertical incision over the midmanubrium. The suprasternal notch was exposed and the soft tissues were retracted to expose the entire manubrium and upper part of the sternum down to the level of the third interspace. The mediastinal tissues were carefully freed from the undersurface of the manubrium and a short section of the sternum down to the third interspace. The mediastinal structures were protected with a thin spatula and the manubrium split in the midline, carrying the division downward into the sternum to the level of the third interspace and laterally, connecting these interspaces on either side. The manubrium and sternum were then retracted widely by a rib-spreader retractor. This gave good exposure of the entire superior mediastinum and the arch of the aorta. The innominate, or whatever great vessel was involved, was then isolated at its origin from the arch of the aorta and a catheter passed around it for tourniquet action. The innominate vein was also isolated and controlled in a similar way. Just beyond the bifurcation of the innominate vessels the subclavian and common carotid arteries and their associated veins were isolated and likewise controlled with catheters. Finally, with full control both proximally and distally by means of traction on the catheters or rubber-covered arterial clamps the aneurysmal sac was isolated and the injured section of the artery excised after careful ligation both proximal and distal to the laceration. The manubrium was then wired together and the superior mediastinum drained with a simple Penrose drain.

When these principles were observed, the mortality and complications were minimal, with only an occasional swelling and weakness of the upper extremity. No amputations were necessary and no treatment was required for any unusual circulatory disturbance in this respect. The extremity in question should, however, be carefully watched and kept exposed at room temperature, and every effort made to avoid constriction from clothing or position. Should significant circulatory disturbance develop, antispasmotic drugs and sympathetic blocks should be used. The patients recovered rapidly, but the function of the upper extremity was variable, depending on the degree of the original associated damage to the nerves and muscles. The lack of circulatory complications was undoubtedly the result of the age of these patients, and most probably this procedure could not be used in an older group of patients without serious circulatory complications.

COMMENT

This review of elementary principles was directed toward those whose contact with thoracic injury has been casual. Be the patient military or civilian, understanding of these basic principles will measure the success that attends the surgeon's therapy. The surgical judgment or decision as to when to initiate the specific measures of therapy is based on the correct interpretation of symptoms, physical signs, laboratory studies, and roentgenograms. The mastery of these diagnostic considerations is therefore mandatory. Although standardization of the resuscitative, reparative, and reconstructive measures is not possible as applied to an individual patient or even to a single surgeon, the success of these various methods as outlined has brought a new order to the management of thoracic injuries.

Notes on Field Surgery

Spurgeon H. Neel, Jr., *Major, MC, U. S. A.* (1)

FUNDAMENTALLY, there is no difference between operations accomplished under field conditions and those performed in garrison or large medical centers. The tissues of the combat soldier react to trauma and bacterial invasion in exactly the same manner as those of the civilian in mufti. The healing processes are identical and depend just as much on the previous state of nutrition and the skill of the surgeon. The combat soldier is heir to all the illnesses and injuries which plague his civilian comrade plus those injuries peculiar to modern warfare. These latter injuries, often incurred under the most adverse circumstances, are new to the junior field surgeon and deserve special comment. The basic physiologic and pathologic processes associated with war wounds are the same as those noted in more conventional injuries, but the complicating factors, methods of handling, and limitation in facilities are peculiar to the battlefield and the men who fight and die there.

The field surgeon is fortunate in that his clientele are selected young men, in excellent health, who have been thoroughly trained and conditioned for combat. Surgery in this select group would be rather simple were it not for the fact that war wounds are usually incurred under the most unhygienic conditions in tired, dirty men, who may not have eaten recently. The treatment of these serious wounds is hampered by the tactical military situation and equipment limitations in the light mobile forward medical units.

Definitive surgery is not the mission of the field surgeon and is beyond the capability of his medical installations. Further burdening of tactical medical units with heavy bulky surgical equipment and additional personnel would immobilize them to the extent of precluding effective close-in emergency medical care. The mission of the field surgeon and his installations is to provide emergency medical care to casualties and prepare them for evacuation to higher medical echelons. The extent of the technical procedures performed depends on the facilities available, the skill of the surgeon, but most of all on the tactical situation. Any procedure required to save life may and must be

(1) 82nd Airborne Division, Fort Bragg, N. C.

accomplished by the field surgeon. The life of the individual soldier is the prime consideration. In independent operations such as airborne assaults or units isolated by enemy action, evacuation may be impossible and the field surgeon will be required to perform procedures normally within the province of higher medical echelons. An inflexible limitation on surgical procedures permitted is impossible and undesirable. The clinical judgment of the individual doctor is the final deciding factor, and no surgeon will be censured for doing what was necessary to save life. Whether the patient lives or dies depends on his treatment in the forward combat area; his length of convalescence and ultimate effectiveness is decided in hospitals to the rear. The flexibility of forward medical service and the responsibility resting on the field surgeon require a familiarity with the characteristics of battle wounds, and medical expedients, in addition to a complete basic knowledge of medicine and surgery.

The importance of proper nutrition, particularly adequate protein and vitamin intake, to the healing of any type of wound is well established. Present Army field rations are adequate to preserve proper nutrition over varying periods of time *provided* they are consumed in toto. Many soldiers discard the vitamin supplements such as powder for making fruit drinks. This practice may lead to a vitamin C deficiency sufficient to cause dental and gingival disturbances and interfere with proper wound healing. Commanders must insure that troops eat their full ration despite remarks concerning the monotony or lack of palatability. I once had to resort to removing vitamin supplement powder from rations as issued, have a "punch" made in conjunction with the noon meal, and require each man to drink one canteen cup of the concoction. A little drastic, I'll admit, but the dental health of the company improved. Assault-type canned or boxed rations should not be issued except as required by genuine military exigency. A proper ration, aside from its morale value, may be lifesaving to a soldier wounded in battle.

Cleanliness to a combat soldier is more than a virtue. High speed penetrating missiles, and especially shell fragments, characteristically carry pieces of clothing into the wound with them. The temperature of the missile or fragment renders them relatively sterile, but the pieces of clothing introduced into the contused devitalized wound may be contaminated by a variety of aerobic and anaerobic organisms. These organisms thrive in the environment of a combat wound, delay healing, and are difficult to treat even with antibiotics. A soldier entering action with a clean skin, clean underwear, and preferably a clean uniform has a much better chance of survival, if wounded, than a dirty soldier. A soldier should dress just as carefully for combat as for leave.

A soldier should evacuate both his colon and bladder before going into battle. Preaction anxiety facilitates both of these functions, but deterrents such as freezing weather, a small fox hole, and enemy fire

may preclude fulfillment of these desires. A full viscus is more likely to be penetrated by shell or bone fragments than one which is empty and flaccid. Bowel or bladder injury is virtually unknown in parachute injuries because of the anxiety in the marshalling area. Pelvic injuries caused by automobile accidents, by contrast, are often associated with bowel or bladder injury because many persons neglect to stop long enough to relieve themselves.

Wounds about the head and neck are occasionally associated with strangulation due to obliteration of normal airways and aspiration of blood or vomitus. Emergency tracheotomy is a lifesaving procedure in patients with such wounds. The minimal equipment required for this procedure is available in any forward medical facility. Unconscious patients require no anesthetic and local anesthesia is sufficient for most others. "Fountain-pen" tracheotomies were relatively common in World War II. Tracheotomy, when indicated, will not wait for evacuation to a hospital. It must be performed on the spot. In World War II, I stood helplessly by in a collecting station and watched several men die from strangulation by blood and vomitus. I remained helpless until a technician, fifth grade (now called private, first class) connected a section of plasma tubing to the windshield wiper nipple on the intake manifold of a jeep and presented me with a cumbersome but workable suction apparatus. I added the refinement of a two-holed stoppered plasma bottle to catch the blood and prevent its entering the engine, and had at my disposal an effective reliable suction machine. Strangulation ceased to be a problem.

Sucking wounds of the thorax, associated with pendulum swinging of the mediastinum, trauma to the heart, and shock to the patient, are fairly frequent problems in combat. The wound is easily closed with a wide strip of adhesive tape tightly applied over a sterile gauze compress, but gradual decompression of the pneumothorax is a more difficult problem. Aspiration with a syringe but no manometer is a tedious process fraught with danger. This problem was solved for me by a dentist with a mechanical bent and practical knowledge of physiology. He shortened a plasma needle, ground away its sharp edges and fitted a condom to its hub with a rubber band. He cut away the closed end of the condom making an effective one-way flutter valve. After closing the sucking chest wound, he prepared a skin area, nicked it with a scalpel and inserted his sterile needle-condom apparatus. As the patient breathed, he progressively decompressed his pneumothorax, came out of shock, and recovered uneventfully. I used this method on many other pneumothoraces with consistently good results.

The absence of proper lighting in forward medical units was another impediment to effective field surgery in World War II. Command-post type portable lights using wet-cell batteries have now been included in tactical medical tables of equipment to offset this deficit, but an expedient used in World War II is still worthy of mention. Vehicles forward of the Army light line normally have their horns and

lights disconnected to preclude accidental betrayal to the enemy. Headlights complete with reflectors may be removed easily from utility vehicles. Two headlights connected by a long extension wire to the battery in a vehicle stationed immediately outside a blacked-out treatment facility will provide a source of constant reliable light for surgical procedures night or day.

These innovations are mentioned, not with the idea of claiming any credit for their discovery, but with the idea of illustrating two important principles of field surgery. The first principle is that effective lifesaving operations can and must be performed in forward medical installations by combining a sound medical background with "Yankee" ingenuity" in the development and use of field medical expedients. The second principle is that the tactical medical unit functions as a team. The surgeon must use each member of his team to the fullest extent. The mechanic with his suction apparatus, and the dentist with his pneumothorax decompression device are but examples of the teamwork which can and must exist in forward medical installations. The surgeon must work through his assistants. Each procedure must be accomplished by the person with the least training who is capable of the task. Thus, more highly skilled personnel are conserved for more technical duties. Each has his job and all contribute to the ultimate mission of the Medical Service: conserving fighting strength.

Biliary Regurgitation During Cholangiography

Seymour A. Kaufman, *Lieutenant, U.S.A.F.R. (MC)*[1]

THE appearance of dye in the kidney pelves during cholangiography has puzzled investigators for many years. The route of biliary regurgitation has been the subject of much speculation and it has only been lately that any light has been shed on the problem. My purpose in this article is to report a patient with such a phenomenon who also presented an additional, interesting roentgenologic finding.

CASE REPORT

A 29-year-old, white, married woman, mother of three children, was admitted with a history of severe pain in the right upper abdominal quadrant of 1 month's duration following her last delivery, and mild epigastric discomfort of 6 month's duration frequently associated with eating fatty foods. The severe pains were relieved by morphine and antispasmotics. She denied jaundice, dark urine, clay-colored stools and weight loss. On cholecystography 2 weeks prior to admission the gall bladder was poorly visualized.

Physical examination revealed a somewhat obese young woman with no jaundice of skin or sclera. The abdomen showed no tenderness, rigidity, or masses. The urinalysis was negative except for a trace of bile reported on one examination. Urobilinogen was positive in the undiluted specimen only. The icteric index was 19.9. The prothrombin time was 15 sec. (100 percent). The plasma proteins were 6.4. The blood cholesterol was 250. The cephalin-cholesterol flocculation test was positive after 24 and 48 hours. The direct van der Bergh's test was positive. The serum bilirubin was 7.2 mg. per 100 cc.

Five days following admission a cholecystectomy with exploration of the common duct was performed. The gallbladder was found to be tense with numerous omental adhesions. The cystic duct was dilated to 0.8 cm. in diameter and was filled with 6 small mulberry-type calculi. The common duct exploration was made through an opening in the common duct 1 inch distal to the cystic duct. Clear watery bile was encountered. Palpation, irrigation, and probing gave no evidence of a stone

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in the common duct, either in its free or in its retroduodenal portion. A No. 14 rubber T-tube was then inserted. The pathologist's diagnosis was chronic cholecystitis with gallstones consisting of 100 percent cholesterol.

About 48 hours after the operation the patient had a severe pain in the right upper abdominal quadrant. This was followed by slight clinical icterus. The patient responded well to analgesia and antispasmotics and had no recurrence of pain. On the fifth postoperative day a cholangiogram was performed using 35 percent diodrast. This revealed a common duct obstruction at the ampulla. There was complete filling and distention of the bile ducts and a peculiar honeycombed collection of dye over the liver area (fig. 1). No dye was seen to enter the duodenum. In 10 minutes the contrast medium was no longer seen overlying the liver but was visualized in the kidney pelves and ureters.

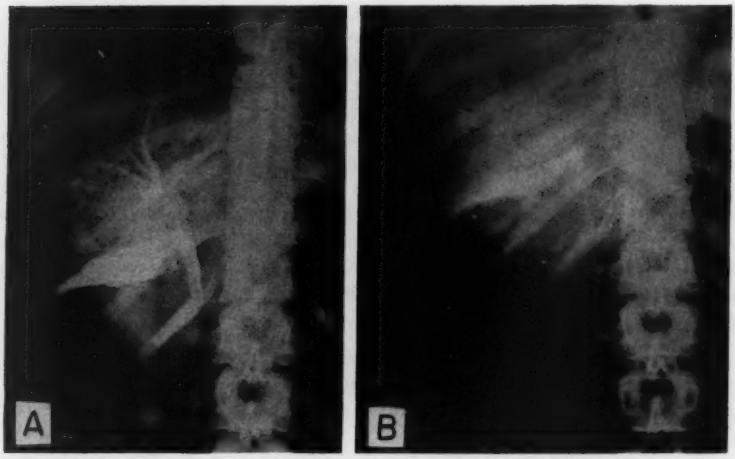

Figure 1. (A) *Two to four minutes following injection of diodrast.* (B) *Ten minutes following injection. Dye is seen in the right pelvis and ureter.*

On the following day the patient was returned to the operating room. Exploration of the previous operative area showed the T-tube properly placed in the common bile duct. The T-tube was removed. Exploration of the common duct again revealed no evidence of stone by palpation, irrigation, and probing. A No. 10 F ureteral catheter was passed through the old exploratory opening in the common duct through the ampulla into the duodenum without difficulty and palpation again failed to reveal stone around this tube. The duodenum was now opened along its longitudinal axis in its second portion and the ampulla region explored from within. No stone was found. A No. 20 F rubber T-tube was then threaded over the ureteral catheter and fixed to it by stitches. The ureteral catheter was then pulled out through the duodenal opening

until the No. 20 F catheter had reached the ampulla. A sphincterotomy was then performed. This resulted in the liberation of a small impacted mulberry-type pigmented calculus which was removed and the T-tube threaded into the intestine. The proximal end of the T-tube was cut 1½ inches long and placed into the common duct as well. This gave the patient a clear communication between the liver and the duodenum with the distal limb of the T-tube projecting 4 inches down the duodenum.

The patient made an uncomplicated recovery. Laboratory findings prior to discharge were: icteric index 5.3; cephalin-cholesterol flocculation test was plus-minus at 24 hours and positive at 48 hours; direct van den Bergh's test negative; serum bilirubin 0.97 mg. per 100 cc.; urine urobilinogen negative; plasma proteins 7.04; and A/G ratio 1.3/1. The patient was discharged with the T-tube in place and instructed to return to the outpatient department for observation.

DISCUSSION

Mixer et al.[2] recently summarized the literature on biliary regurgitation during cholangiography and presented experimental observations. They noted, in their patients, that regurgitation occurred only when the contrast medium was used in patients with partial or complete obstruction of the ampullary end of the common bile duct. These patients had not only complete filling of the biliary duct system but one or both of the kidney pelves contained dye on several films of any one series.

The route followed by the dye, from its injection into the biliary tree to its appearance in the kidneys, is not entirely clear. Earlier investigators thought that there were direct communications between the bile capillaries and the blood capillaries of the liver. Others, on the basis of similar experimental evidence and histologic study of injected liver specimens, concluded that regurgitation took place chiefly through the hepatic lymphatics and the thoracic duct. Recently it has been concluded that regurgitation took place through a combination of both routes, depending on the stage of obstruction and the pressure applied to the biliary tree. In general, with lower pressures applied to the bile ducts, the main route is through the lymphatics; and at high pressures regurgitation has been demonstrated to take place directly into the hepatic sinusoids.

Mixer et al.[2] worked with dogs, using diodrast, thorotrast, bacteria (*Staphlococcus aureus*) and radioactive phosphorus. They concluded that diodrast reached the kidneys by regurgitation through the liver into the blood stream rather than by simple absorption through the biliary duct mucosa. It was found that bacteria and other insoluble particles (thorotrast) could be forced directly into the blood stream, thus explaining the febrile reaction often seen in patients with infected biliary

[2]Mixer, H. W.; Rigler, L. G.; and Gonzalez Oddone, M. V.: Experimental studies on biliary regurgitation during cholangiography. Gastroenterology 9: 64-80, July 1947.

tracts following cholangiography. This was thought to be caused by rupture of the bile canaliculi so as to allow the passage of such colloidal matter directly into the blood stream. Very little pressure is needed to fill the biliary tree completely; it need be only slightly above the hepatic secretory pressure. The use of unnecessarily high pressure while injecting the dye has been cautioned against[3]. Radioactive phosphorus injected into the biliary tree could be traced in both the great veins and the thoracic duct, showing that the lymphatics were also involved in regurgitation as indicated above.

Of particular interest in this patient is the peculiar appearance of a collection of dye over the liver area. Although the cause of this unusual collection of dye is not apparent, it may represent diodrast distributed through the liver substance in the sinusoids. The obstruction of the ampullary end of the common duct resulted in dilatation of the biliary tree from the common duct up to and including the intrahepatic biliary radicles. The dye was inadvertently injected under slightly higher pressure than was necessary and this pressure was readily transmitted through the dilated, smaller biliary radicles to the sinusoids of the liver. This may have enhanced the transitory pooling of the dye in the liver. The dye over the liver area was seen very shortly after the injection but was no longer seen after it had appeared in the kidney pelves. Thus, it might be assumed that after briefly causing opacity in the liver sinusoids, the dye entered the venous circulation to be seen a few minutes later in the kidneys.

Whether the dye visualized was in the liver sinusoids cannot be definitely decided. The radiographs of this patient were widely distributed for examination by radiologists, none of whom could either recall having seen a similar distribution or offer any explanation for it. These findings further emphasize the advisability of both immediate and postoperative cholangiography because in spite of adequate surgical technic in common duct explorations, a few patients will require re-exploration to uncover common duct stones[4-6].

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[3]Hicken, N. F.; McAllister, A. J.; Franz, B.; and Crowder, E.: Technic, indications and value of postoperative cholangiography. Arch. Surg. 60: 1102-1113, June 1950.

[4]Hicken, N.F.; Stevenson, V. L.; Franz, B. J.; and Crowder, E.: Technic of operative cholangiography. Am. J. Surg. 78: 347-355, Sept. 1949.

[5]Hughes, C. R.; Hannan, J. R.; and Mulvey, B. E.: Cholangiography in stone stricture and operative injury of biliary ducts. J. A. M. A. 137: 687-690, June 1948.

[6]Collett, H. S.; Caylor, H. D.; and Tirman, W. S.: Choledocholithiasis. Am. J. Surg. 80: 514-522, Nov. 1950.

Orthopedic Concepts in the Management of Rheumatoid Arthritis

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THE diagnosis and treatment of arthritis and allied conditions have become so complex that special training and study of these conditions are required of physicians. A rheumatology clinic should be established at any clinic or hospital which manages more than an occasional arthritic patient (2). Such a clinic should comprise the rheumatologist, the orthopedic surgeon, the physiatrist, and, occasionally, the radiologist and psychiatrist. The patients should be seen jointly in the clinic by this group and passed on to the appropriate member for treatment. When such treatment is completed, or periodically reviewed prior to completion of treatment, the patient should be returned to the clinic for further evaluation.

The orthopedic surgeon can offer much help to the arthritic patient by the judicious use of appliances, casts, and selective use of surgical procedures available to him. The orthopedic surgeon should be consulted early in the management of arthritic patients to assist in the prevention of deformities rather than waiting, as is too often done, until crippling deformities have developed. The role of the orthopedic surgeon in the management of arthritis is similar to his role in the management of poliomyelitis and his judgment, skill, and ingenuity are equally taxed.

Although the orthopedic surgeon has a number of procedures in his armamentarium, it behooves him to enter on such projects with full realization of his limitations, and a realization that his final results will not be as satisfactory as those in traumatic or postpoliomyelitis cases and that the reparative potentialities of a rheumatoid arthritic patient are decreased. He must be prepared to perform multiple pro-

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(1) Army and Navy General Hospital, Hot Springs National Park, Ark.

(2) Nicol, A. A. M.; Waugh, W. G.; Cowan, I. C.; and Harkness, J.: Organization of arthritis clinic. Lancet 2: 541, Oct. 2, 1948.

cedures in stages and at times revise his work; this requires great patience on the part of the surgeon and patient alike. He must evaluate the general condition of the patient to withstand such prolonged surgery. He must apprise his patient of these facts and be sure that the patient is willing to put forth the effort needed to obtain the desired results. He must advise his patient that satisfactory results will depend more on the patient's postoperative efforts and cooperation than on the surgical procedure. Without complete cooperation on the part of the patient the results will be most discouraging to doctor and patient alike. There is no short cut to the prevention and correction of the multiple deformities to which many of these patients become victims. The orthopedic treatment must be entered into in conjunction with the general treatment of the disease entity and not be divorced from it.

Too often in the past the idea that nothing can be done by the orthopedic surgeon until the underlying disease is quiescent has resulted in a failure to obtain his advice and consequently deformities not only have not been prevented, but completely crippling deformities have developed *(3)*. This means that the most favorable time for orthopedic treatment has long since passed and far inferior results must be accepted. Although surgical procedures are usually not carried out during the acute, active phase of arthritis, it may be advisable to intervene surgically to prevent further destruction or spread of the process to other tissues.

Better results can be expected and surgical treatment can be used more often in monarticular than polyarticular affections. The treatment of arthritis is directed toward (1) the relief of pain, (2) arrest of the disease, (3) the maintenance of function, (4) the restoration of function, (5) the prevention of deformities, and (6) the correction of deformities. The methods of treatment may be classified as conservative (table 1) and operative.

TABLE 1. *Outline of conservative treatment of rheumatoid arthritis*

1. Rest (local and general)
2. Heat
   a. Hot packs
   b. Hot baths at from 98° to 103° F. may be harmful if temperature is too high or bathing time is prolonged
   c. Heat cabinet
   d. Electric blankets
   e. Paraffin baths at 130° F. using 1 pound of paraffin to 1 ounce of petrolatum
   f. Infrared light
   g. Diathermy*
   h. Fever therapy* (mild: 100° to 105° F.)
      (marked: 105° to 107° F.) (dangerous)
3. Ultraviolet light*
4. X-ray
5. Contrast baths

(3) Law, W. A.: Surgical treatment of rheumatoid arthritis. Practitioner 161: 163-169, Sept. 1948.

TABLE 1. *Outline of conservative treatment of rheumatoid arthritis—Cont'd.*

6. Whirlpool baths (may aggravate the condition)
7. Massage (stroking and gentle kneading only)
8. Ion transference
   a. 2 percent solution of sodium salicylate for spasm and pain, vasoconstriction, effusion, or thickening of capsule
   b. 2 percent histamine or methacholine chloride ointment for thickening of tissues around joint
   c. 1 percent solution of magnesium sulfate for pain
9. General or local refrigeration (now considered valueless)
10. Exercises
    a. Passive
    b. Active assistive
    c. Active
    d. In tank to lessen gravity
    e. Resistive
    f. Breathing
    g. Postural
11. Traction
    a. Head (Sayre halter)
    b. Leg (skin or skeletal)
12. Supportive dressings with all cotton elastic bandage
13. Splints
    a. Rigid—metal or plaster
    b. Active elastic
    c. Bradford frame
14. Braces
    a. Feet—metatarsal bars; heel pads; arch supports or pads
    b. Ankle—short brace with or without joint or cockup
    c. Knee—cage or caliper
    d. Hip—ischial weight bearing
    e. Back—canvas or rigid
    f. Neck—collar
    g. Hand and fingers—elastic to maintain or correct ulnar deviation and flexion
    h. Wrist—cockup
15. Wedging casts
16. Manipulation
17. Procaine therapy
18. Occupational therapy

*Harmful and irritant to patients with rheumatoid arthritis; may result in a breakdown of red blood cells with anemia and increased sedimentation rate.

CONSERVATIVE TREATMENT

As a rule, during the early, active, acute phase of the disease conservative measures are indicated. Rest of the acutely inflamed joint has been the time-honored key to the treatment of these joints, but it has become so ingrained in the minds of most physicians that its use has been greatly overdone (*4*) with the production of harmful end

(*4*) Stengel, E. (New York): Optimal physical therapy for rheumatoid arthritis. New York State J. Med. 48: 1028-1031, May 1, 1948.

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results, in the form of deformities and invalidism, even though attempts have been made to maintain optimal position of joints. Rest, both general, as obtained by bed rest, and local as obtained by casts and splints, is still a very helpful measure in the treatment of arthritis (5, 6). Rest must be employed judiciously by the physician and balanced by a well conceived plan of activity (7). Periods of bed rest throughout the day alternated with periods of activity are to be prescribed, but complete bed rest should be discouraged or prevented. The patients must be encouraged to exercise their joints even though such activity causes some discomfort, but not to a point of causing an exacerbation of symptoms.

Arthritic joints are painful and patients are prone to keep them at absolute rest and assume a flexed position of the joints to prevent pain. Unfortunately, these positions of deformity often are encouraged by doctors and nurses in an attempt to make the patient comfortable. Pillows are placed under the knees, forearms, wrists, or hands, encouraging flexion. In an attempt to keep patients from being bedfast they are allowed to become wedded to wheel chalrs with the result that shoulders, elbows, wrists, hands, hips, knees, ankles, and feet are placed in a constant position of flexion and deformities result. Plaster of paris casts are applied for the relief of pain and spasm, but are too often maintained for prolonged periods, and although the joints are placed in optimal positions stiff or ankylosed joints often result (8).

From the beginning it is important to place a patient on a schedule of activity, teaching him exactly what he should do and how to do it. In the early acute stage rest is important, but must not be prolonged. As soon as exercise can be tolerated the patient should be taught actively to exercise muscle groups supporting affected joints so as to maintain good muscle tone and strength. The joints should be actively carried through a full range of motion. It may be necessary to begin with passive motion of the joint, graduating to active assistive, then active and active resistive exercises. Pain may be alleviated by heat, intravenous or intra-articular procaine, or other medication prior to the exercise period. Every effort should be made to make the patient ambulatory. It is the doctor's responsibility to insist on this activity. If it causes discomfort, he should seek measures to alleviate this discomfort. Undue fatigue is not to be allowed, but activity should be sufficient to maintain muscle tone and joint motion. This program of activity must then be augmented by periods of general bed rest

(5) McCauley, J. C., Jr.: Manipulative treatment and supportive orthopedic measures. In Bach, T. F. (editor): Arthritis and Related Conditions. F. A. Davis Co., Philadelphia, Pa., 1947. pp. 296-310.

(6) Kavanaugh, D. E.: Non-surgical orthopedic management of rheumatoid arthritis. J. M. Soc. New Jersey 46: 421-424, Sept. 1949.

(7) Law, W. A.: Surgery in treatment of rheumatoid arthritis and ankylosing spondylitis. Proc. Roy. Soc. Med. 41: 251-260, Apr. 1948.

(8) Tegner, W. S.: Treatment of rheumatoid arthritis. Lancet 1: 469-472, Mar. 27, 1948.

for the patient and local rest for the affected part. For the spondylitic patient periods of bed rest on the Bradford frame should be prescribed.

The local rest of the affected joint is best obtained by a type of active elastic splint to be worn during the day between periods of exercise. They allow motion and exercise of the joint, maintain the joint in optimal position, and provide support for the part. In this way they assist in preventing the development of deformities and in the correction of deformities already manifested. These splints must be individually designed and require a great deal of ingenuity on the part of both the doctor and brace maker. For night wear a rigid splint of padded metal or plaster of paris should be worn with the joints held in their optimal position.

In order to encourage ambulation use can be made of walkers, crutches, and canes. Frequently the joints of the feet are involved and pressure can satisfactorily be taken off tender heels by the use of doughnut-type heel cushions in the shoes and from the tender metatarsophalangeal joints by the application of metatarsal bars to the sole of the shoes.

In addition to the general medical measures used to relieve pain and arrest the disease, much comfort can be obtained by the employment of physical therapeutic measures of mild heat in any form, such as hot packs, hot baths, heat cabinets, electric blankets, paraffin baths, infrared, and massage *(9-13)*. Heat must be mild because high temperatures are more harmful than beneficial and, at times, dangerous *(9)*. Heat is soothing, relaxes muscle spasm and has an analgesic effect. Light massage improves tone and circulation and reduces edema. Iontophoresis was advocated by Stengel *(4)* as the method of choice to relieve pain, spasm, edema, and thickening about joints, being superior to commonly employed physical therapeutic measures which he claimed are harmful at times rather than helpful.

Mild deformities and pain frequently can be corrected by traction, using Sayre head traction in cervical arthritis and leg traction for deformities of the knee. Manipulation under anesthesia at times may be helpful to correct deformities and should be followed by active exercises to retain the motion gained *(5, 14)*. The use of wedging

(9) Walker, P. J.: Physical therapy in arthritis. Ann. West. Med. & Surg. 2: 320-324, July 1948.

(10) Kistler, P. M.: Physical medicine in treatment of arthritis. The Hahneman. Monthly 83: 164-169, Apr. 1948.

(11) Osborne, S. L.: Rehabilitation in rheumatoid arthritis. Quart. Bull., Northwestern Univ. M. School 22: 340-345, 1948; Rheumatism 4: 229-223, Oct. 1948.

(12) Solomon, W. M.: Physical treatment of arthritis. J. A. M. A. 137: 128-130, May 8, 1948.

(13) Hansson, K. G.: Physical therapy in arthritis. In Bach, T. F. (editor): Arthritis and Related Conditions. F. A. Davis Co., Philadelphia, Pa., 1947. pp. 311-338.

(14) Capener, N.: Orthopedics in rheumatoid arthritis. Brit. M. J. 2: 391-394, Aug. 20, 1938.

casts often is successful in the correction of deformities of joints whereby they may be returned to a position of usefulness *(6, 15)*. Static exercises are important even during the period of wedging to maintain muscle tone and strength so as to be capable of maintaining the corrected position when the casts are removed. As muscle tone, strength, and joint mobility improve, a variety of occupational therapeutic measures may be used to continue the improvement and provide a little variety to monotonous exercises *(16)*. At times these measures may provide a gainful occupation for the patient.

Braces *(5)* are frequently useful following or in conjunction with other forms of therapy to maintain an optimal position of a joint and in preventing the development of deformities. They are employed for almost all joints and must be individually designed.

OPERATIVE TREATMENT

The operative treatment of arthritis is primarily performed to (1) relieve pain, (2) restore or maintain function, and (3) correct deformities. It must be carried out as an adjunct to the medical management, not a substitute for it. The results of operation in rheumatoid arthritis will be less gratifying than similar procedures performed for static or traumatic conditions. This should not deter the surgeon, but should remind him of the difficulties to be encountered and to proceed cautiously. He should inform the patient not to expect a normal member, although some improvement should result. He should also be told that the operation is intended to obtain a certain desired result and that reoperation may be necessary before this result is realized.

Care in the selection of patients for operation is important. The patient must be emotionally prepared for the operation, willing to cooperate fully pre- and post-operatively and physically fit to withstand it.

The orthopedist has an opportunity to employ a great many procedures in the treatment of rheumatoid arthritis. He will find that a single patient will call for a number of these procedures to obtain a single objective. The multiplicity of joint involvement only adds to the magnitude of the job and the time required to complete all procedures. This demands great patience and persistence on the part of surgeon and patient alike.

Among the procedures employed are the following *(17-19)*:

1. The local *injection* of a 2 percent solution of procaine into the joint cavities sometimes mixed with a 5 percent solution of lactic acid (pH 5.2).

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(15) Levinthal, D. H., and Logan, C. E.: Orthopedic and medical management of arthritis; preliminary report. Journal-Lancet 63: 48-50, Feb. 1943.

(16) Brokaw, E. H.: Occupational therapy in treatment of arthritis. In Bach, T. F. (editor): Arthritis and Related Conditions. F. A. Davis Co., Philadelphia., Pa., 1947. pp. 359-363.

2. Double pin *traction* to correct a flexion deformity of the knees (6).

3. *Neurectomy* for the relief of pain, such as of the obturator and sciatic nerves to the hip.

4. Posterior *capsulotomy* for flexion contractures of the knee and of the ankle is sometimes necessary when other measures fail to correct this deformity.

5. *Capsulectomy* is indicated when the articular capsule has become adherent to the joint surfaces and contracted, thereby preventing motion. Removal of portions of the capsule releases this adhesive block and facilitates motion. The proximal interphalangeal joints can at times be restored to function in this manner. The metacarpo- or metatarso-phalangeal joints are especially responsive to this procedure to improve mobility.

6. *Synovectomy* is performed primarily to relieve pain and interference of function caused by a thickened inflammatory synovial membrane. It is doubtful that a synovectomy removes a focus of infection which may spread the disease to other joints.

7. *Resection* of a joint, particularly with advanced destruction, is a valuable method of relieving pain in that joint and results in improved function often with a correction of deformity and cosmetic improvement.

8. *Excision* of parts of bones and joints, as well as hyperostosis which develops around joints, facilitates a freer range of motion such as is observed following excision of the distal end of the acromion.

9. *Tendon transfers* are often a valuable adjunct to other procedures in the treatment of rheumatoid arthritis. The extensor tendons of the toes are often transferred into the neck of the metatarsals following resection of the metatarsal heads.

10. *Débridement* of joints, particularly of the knee joint, removing all damaged and fibrillated cartilage, as well as hyperostosis around the joint and patella, has restored useful painless motion in many cases.

11. *Osteotomies* in the management of arthritis frequently have been used in the hip and knee in an attempt to correct deformities not corrected by other means where some motion remains in the joint. Smith-Peterson has devised a procedure to correct the flexion deformity of the spine by osteotomy through the vertebral articular facets.

12. *Arthrodesis* of joints in optimal functional positions is performed in patients with chronic deformities.

(17) Comroe, B. I.: Arthritis and Allied Conditions. 4th edition. Lea & Febiger, Philadelphia, Pa., 1949.

(18) Mercer, W.: Orthopedic Surgery. 3rd edition. Williams and Wilkins Co., Baltimore, Md., 1944. pp. 389-433; 840-859.

(19) Speed, J. S. (editor): Operative Orthopedics (Campbell's). 2nd edition. C. V. Mosby Co., St. Louis, Mo., 1949. pp. 837-907.

13. In order to return mobility to ankylosed joints a variety of *arthroplasties* have been devised employing fascia, metal or acrylic as interposing materials. These procedures have been particularly adaptable to the metacarpophalangeal joints of the hands, to the elbows, and to the hips, and some encouraging results have been seen in the knee.

14. A great variety of *reconstructive procedures* have been devised to improve function of joints.

15. As a last resort for the relief of incessant pain *cordotomies* have been performed.

With reference to location, operative procedures which have been found beneficial in the relief of pain and improving function include those directed to (1) the lower extremity, (2) the upper extremity, and (3) the back (*3, 7, 20, 21*).

Lower extremity. In the lower extremity operative treatment should result in a painless, stable extremity for weight bearing. Any of the joints of the lower extremity may be involved in the arthritic process and seriously hamper locomotion. The small joints of the foot are often involved with a resultant clawing of the toes, hallux valgus deformity of the great toe, subluxation of the metatarsophalangeal joints, pain and deformity in the midtarsal and ankle joints, and pain and periostitis about the os calcis.

The clawtoe deformity can effectively be corrected by resection of the proximal interphalangeal joint and arthrodesis of this joint, together with tenotomy or transfer of the extensor tendons. The depression and subluxation of the metatarsophalangeal joints can be corrected by resection of the metatarsal heads. This latter procedure will sometimes allow straightening of the toes by shortening the osseous structure, thereby relaxing the contracted soft tissues. Resection of 1, the middle 3, the lateral 4, or all of the metatarsal heads has been performed on a number of patients with satisfactory results. I have found it advantageous to transfer the long extensor tendon to the neck of the metatarsal bone in addition to resection of its head. The hallux valgus deformity is best treated by the Keller operation.

Persistent pain, swelling, and deformity in the midtarsal joints are best treated by arthrodesis of these joints, although this has not often been found necessary. The periosteal reaction about the os calcis produces spurs which rarely, if ever, require surgical excision.

The ankle joint when involved tends to cause the foot to go into an equinus deformity if not properly protected. This deformity at times can be corrected by posterior capsulotomy and lengthening of the tendo

(*20*) Bach, T. F.: Orthopedic intervention in arthritis. In Bach, T. F. (editor): Arthritis and Related Conditions. F. A. Davis Co., Philadelphia., Pa., 1947. pp. 419-429.

(*21*) Levinthal, D. H.; Logan, C. E.; Kohn, K. H.; and Fishbein, W. I.: Practical management of arthritis—medical and orthopedic. Indust. Med. 13: 377-386, May 1944.

achillis when wedging casts fail. Persistence of pain and deformity are indications for arthrodesis of this joint.

The knee joint is commonly involved early. It may only appear as a synovitis and respond to aspiration and elastic bandaging; but as the synovia becomes thickened, synovectomy offers an excellent means of relief. In more severe cases with uncorrected flexion contracture, posterior capsulotomy often will allow for correction of the deformity. In some cases with slight range of motion and flexion deformity persisting after other means fail, an osteotomy of the lower end of the femur will facilitate complete extension of the leg on the femur while maintaining the degree of flexion present. When the joint has been destroyed by the arthritic process, arthrodesis of the knee is the procedure most likely to result in a painless stable knee. When both knees are involved the patient is severely handicapped and arthroplasty of at least one should be considered. This procedure has not been extensively used, but offers great promise. Either fascial covering or Smith-Peterson vitallium knee plates may be used.

The ideal treatment of the hip joints is one which succeeds in obtaining a painless full range of motion with a stable joint. Unfortunately, this ideal is seldom realized. The fact that so many operations have been devised for this joint bears witness to the shortcomings of most. In cases of bilateral involvement it is often necessary to sacrifice stability for mobility when both features cannot be obtained. At times the condition of the patient precludes extensive surgical intervention; but it is imperative to do something to relieve pain. Occasionally this can be accomplished by an obturator neurectomy with or without neurectomy of the sciatic branch to the hip joint as employed in osteoarthritis. With severe pain and marked involvement of the joint the Girdlestone procedure with resection of the head and neck of the femur will relieve the pain and result in a mobile hip with fair stability *(22)*. Displacement osteotomy of the femur sometimes results in a painless hip because of altered and improved mechanics.

Arthrodesis of the hip produces a stable painless joint, but many patients object to the resultant lack of mobility. With bilateral involvement and in joints which have ankylosed it is desirable to produce mobility in at least one joint. This may be obtained by a Jones pseudarthrosis on one side or Smith-Peterson mold arthroplasty on one or both sides or with a metal or plastic hip prosthesis. When performing such an operation for rheumatoid arthritis the surgeon must be prepared to repeat the operation one or several times before succeeding in obtaining the desired results.

Upper extremity. The joints of the hand and wrist are commonly involved in severe disabling deformities with dislocations of the

(22) Batchelor, J. S.: Excision of femoral head and neck for ankylosis and arthritis of hip. Overseas Postgrad. M. J. 2: 448-456, July 1948.

interphalangeal and metacarpophalangeal joints and flexion deformity of the wrist. These deformities can be corrected at times by resection of the interphalangeal and metacarpophalangeal joints. At times it is more desirable to fuse the interphalangeal joints in a functional position. Arthroplasty of the metacarpophalangeal joints is highly successful in producing a painless, mobile joint in good alinement.

With marked deformity of the wrist it becomes desirable to ankylose the carporadial joint. If pain is marked in the distal radioulnar joint resection of the distal end of the ulna provides relief. Involvement of the proximal radioulnar joint can often be relieved by resection of the head of the radius and partial synovectomy of the elbow joint. With more marked involvement of the elbow joint, arthrodesis or arthroplasty of this joint should be considered.

Involvement of the shoulder joint in the arthritic process results in involvement of the periarticular structures including the bursa. Much relief of pain and improvement in range of mobility will result from a Smith-Peterson's acromioplasty. When there is more marked involvement of the joint, arthrodesis of this joint may become necessary to relieve the pain and place the shoulder in a more favorable position.

Spine. In patients with spondylitis associated with a severe kyphosis, Smith-Peterson has devised a procedure whereby a wedge osteotomy is performed through the intra-articular facets and the spine is hyperextended and fused. This allows the patient to assume a more upright position.

Jaw. The temperomandibular joint is occasionally involved with pain, inability to open the jaws, and subsequent ankylosis. Resection of the condyles of the mandible usually relieves this condition.

CONCLUSION

By a careful and judicial selection of patients and procedures adapted to any particular joint, patients may be relieved of their pain, deformities may be corrected, and the function of the joints may be improved. The patients are thereby prevented from becoming hopeless cripples, are made ambulatory and may even regain the ability to carry on some type of gainful occupation.

Meckel's Diverticulum Containing Heterotopic Tissue

Report of a Case

John R. Weisser, *Captain, MC, U. S. N. (1)*

PERSISTENCE of the vitello-intestinal duct in postnatal life, designated as Meckel's diverticulum, is not uncommon, occurring in from 1 to 4 percent of infants. Because it normally connects the midgut to the yolk sac in the first weeks of fetal life, it is understandable that it may be the site of aberrant tissues derived from the developing midgut. Heterotopic tissue is reported to occur in about 20 percent of Meckel's diverticulums and in about 65 percent of those with symptoms. Such aberrant tissue may be gastric or duodenal mucosa or pancreatic tissue, or a combination of these. The finding of more than one type seems to be rare. According to a recent survey of the literature by Bigelow and Clark *(2)*, the presence of both pancreatic tissue and gastric mucosa has been reported in only 8 patients. It is believed that aberrant tissue in a Meckel's diverticulum predisposes to the production of symptoms.

CASE REPORT

A 20-year-old man was admitted to the U. S. Naval Hospital, Quantico, Va., on 7 July 1948 complaining of abdominal pain and nausea for the preceding 24 hours. The family history and the past medical history were not significant, and inventory by systems revealed no other complaints. The physical examination was negative except for point and rebound tenderness just to the right of and below the umbilicus with muscle guarding and spasm of the right rectus abdominis muscle. The white blood cell count was normal. The persistence of signs and symptoms indicated the need for operation. The preoperative impressions, in order, were acute appendicitis, regional enteritis, and

(1) U. S. Naval Hospital, Great Lakes, Ill.

(2) Bigelow, R., and Clark, D. E.: Heterotopic pancreatic tissue and gastric mucosa in Meckel's diverticulum. Arch. Surg. 60: 157-163, Jan. 1950

inflammation of a Meckel's diverticulum. On operation the appendix appeared normal. The omentum was thickened, vascular, and adherent to the ileum in the area medial and cephalad to the appendix. About 16 inches proximal to the ileocecal junction the omentum was wrapped adherently about an inflamed, indurated, edematous Meckel's diverticulum which measured 7 cm. in length and 2.5 cm. in diameter. The diverticulum was excised, the bowel closed, and an appendectomy was also performed. Convalescence was uneventful and the patient returned to duty on 20 July 1948.

On gross examination the Meckel's diverticulum measured 5 cm. in length and 3.7 cm. in circumference. The serosal vessels were injected and mucosa was thrown into prominent folds. The microscopic examination of the appendix showed the lumen to be filled with fecal material. The mucosa and submucosa were infiltrated with lymphocytes. The lymph follicles were prominent. The muscularis was normal. The serosal vessels were slightly congested. The microscopic examination of the Meckel's diverticulum showed it to be lined over a large area by mucosa, resembling that of the ileum. This area contained prominent Peyer's patches. In other areas the mucosa was of the jejunal or the gastric type. In another portion pancreatic tissue was found. The mucosa was infiltrated by moderate numbers of lymphocytes and plasma cells. The pathologic diagnosis was chronic appendicitis and Meckel's diverticulitis with aberrant gastric mucosa and pancreatic tissue.

DISCUSSION

Although diverticulums containing heterotopic tissue more commonly produce symptoms, it is possible that diverticulums with symptoms have been studied more completely and thus heterotopic tissue has been detected more frequently. A correlation of symptoms with the types of heterotopic tissue, or a combination of these, has not been established. Bigelow and Clark (2) suggest that the presence of alkaline-secreting pancreatic tissue may prevent ulceration of acid-producing gastric mucosa. In the case reported by Troll (3), in which both of these heterotopic tissues were present, ulceration, hemorrhage, and perforation occurred.

(3) Troll, M. M.: Aberrant pancreatic and gastric tissue in intestinal tract. Arch. Path. 38: 375-380, Dec. 1944.

Preoperative Diagnosis of Meckel's Diverticulum

George Alvary, *Major, U. S. A. F. (MC)* (1)

IN A condition which occurs as frequently as Meckel's diverticulum, it seems highly probable that the blame for the failure to diagnose this lesion more often rests on the radiologist (2). Meckel's diverticulum represents the persistent remains of the fetal omphalomesenteric duct which communicates between the yolk sac and the primitive digestive tube. It degenerates by the seventh week of embryonic life and its persistence results in an anomaly which occurs in from 1 to 3 percent of persons; is usually recognized between the ages of 10 and 30 years; and occurs in men 3 times as often as in women (3).

Although about 70 percent of those persons with this condition go through life without requiring an operation for one of its complications (4), the diagnosis of Meckel's diverticulum before operation is seldom made. It is frequently suspected clinically in patients seen prior to appendectomy and, occasionally, the diverticulum is found to be the real cause of the symptoms. The roentgenographic demonstration of the diverticulum preoperatively is rarely possible (3, 5-9) and in the lifetime of several roentgenologists has never been accomplished

(1) Westover Air Force Base, Mass.

(2) Rousseau, J. P., and Martin, A. G. M. III.: Meckel's diverticulum; preoperative roentgen diagnosis. Radiology 40: 605-607, June 1943.

(3) Howell, L. M.: Meckel's diverticulum; consideration of anomaly, with review of 61 cases. Am. J. Dis. Child. 71: 365-377, Apr. 1946.

(4) Allemann, R.: Zur Diagnose und Therapie des chronischintermittierenden subtotalen Ileus. Schweiz. med. Wchnschr. 64: 331-333, Apr. 14, 1934.

(5) Prévôt, R.: Meckelsches Divertikel im Röntgenbild. Röntgenpraxis 8: 397, June 1936.

(6) Foucault, P.: A propos de la radiographic du diverticule de Meckel. Mem. Acad. de chir. 64: 313-318, Feb. 23, 1938.

(7) Case: cited in Bockus, H. L.: Gastroenterology. W. B. Saunders Co., Philadelphia, Pa., 1944. Vol. II, pp. 120-122.

(8) Golden, R.: Radiologic Examination of the Small Intestine. J. B. Lippincott Co. Philadelphia, Pa., 1945.

(9) Owen, J. K., and Finney, G. G.: Surgical aspect of Meckel's diverticulum. South. M. J. 42: 98-108, Feb. 1949.

successfully. Golden *(8)* stated that he never succeeded in demonstrating one even in a patient in whom he knew that a Meckel's diverticulum had been found at a previous operation. Although I do not recommend extensive roentgenographic studies for patients who are acutely ill and need surgical treatment, roentgenographic investigation should be made on patients with persistent pain in the right lower abdominal quadrant unrelated to taking food, associated with flatulence, and occult blood in the stools over a prolonged period, because it is in these patients that the diverticulum will be most frequently demonstrated preoperatively. The first case of Meckel's diverticulum diagnosed roentgenographically and proved by operation is credited to Case *(7)*. Several others have been reported since *(2, 4-6, 10-17)*.

CASE REPORT

A 25-year-old Air Force sergeant was admitted to the hospital on 26 January 1951 complaining of intermittent pain in the right lower abdominal quadrant of 5 days' duration. Prior to that time he was well. The pain in the abdomen was not relieved by taking food or alkali. The pain was at times cramplike and at other times gnawing in character. On physical examination tenderness was noted on deep palpation just below and to the right of the umbilicus. No occult blood was present in the stool on a meat-free diet.

A gastrointestinal series demonstrated the Meckel's diverticulum just to the right of the midline (fig. 1). A lateral view taken at the same time (fig. 2) showed a coiled-up appendix filled with barium, high in the retrocecal position. The 5-hour plate (fig. 3) showed barium retained in the Meckel's diverticulum. Its tip was the typical bulbous variety referred to as the "cherry hanging by its stalk" *(4)*. This configuration is the result of constriction by adhesive bands running in a horizontal direction.

An exploratory laparotomy was performed on 19 February. The configuration of the bowel and the diverticulum as seen at operation is

(10) Soper, H. W.: Roentgen-ray diagnosis of lesions of small intestines. Am. J. Roentgenol. 22: 107-119, Aug. 1929.

(11) Mondor, H., and Lamy, M.: Etude clinique des ulcères du diverticule de Meckel. J. de chir. 41: 553-584, Apr. 1933.

(12) Leveuf, J.; Leroux, R.; and Perrot, A.: Trois cas de persistance du canal omphalo-mésentérique (fistule ombilicale congénitale). Ann. d'anat. path. 12: 1015-1029, Dec. 1935.

(13) Dixon, C. F.; Deuterman, J. L.; and Weber, H. M.: Diverticula of intestine. Surg., Gynec. & Obst. 66: 314-321, Feb. (No. 2A) 1938.

(14) Ehrenpreis, B.: Roentgen diagnosis of Meckel's diverticulum. Am. J. Roentgenol. 42: 280-284, Aug. 1939.

(15) Buckstein, J.: Clinical Roentgenology of the Alimentary Tract. W. B. Saunders Co., Philadelphia, Pa., 1940.

(16) Robinson, W. W.: Meckel's diverticulum; its demonstration by continuous barium-stream. Memphis M. J. 19: 8-9, Jan. 1944.

(17) Butler, G. V.; Remington, A. C.; and Remington, J. H.: Preoperative demonstration of Meckel's diverticulum. Medical Radiography and Photography 26: 122-124, 1950.

Figure 1. Three-hour film. The terminal ileum and much of the colon is outlined. The Meckel's diverticulum is seen side by side and in close proximity with the efferent loop of ileum. There is no barium anywhere proximal to the attachment of the diverticulum. Note the tip of the appendix as it emerges from behind the cecum. Figure 2. Three-hour film. Lateral view showing the shadows of the diverticulum and efferent intestinal loop superimposed on each other. This indicates the approximate diameter of the diverticulum filled with barium. The appendix is in full view. Figure 3. Five-hour film. Meckel's diverticulum is demonstrated by its ability to retain the barium mixture. The efferent loop of ileum is almost empty. Figure 4. Diagram showing the anatomy of the bowel as encountered at operation. At the attachment of the diverticulum, about 80 cm. from the ileocecal junction, the ileum is sharply angulated. The defect above the "head" was caused by adhesive bands within the mesentery.

shown in figure 4 Almost all of the barium mixture shown in the 3-hour plates was contained in a single loop of terminal ileum. The last few inches of the terminal ileum appeared almost as a straight tube. The diverticulum was seen hanging from the small intestine by a narrow base. At this point the intestine showed the characteristic sharp angulation. The diverticulum pointed downward. Deeply imbedded in the mesentery of this large loop the tip or "head" of the diverticulum was partitioned off by constricting fibrous adhesions as demonstrated by the roentgenogram. The diverticulum was dissected out and was excised together with the normal-appearing appendix. At operation no true diverticulitis was present but rather a mechanical disability existed which was caused by retention of food or barium in this blind loop that emptied with difficulty because of its dependent position, small opening, and angulation of the bowel at its insertion. The tip of the diverticulum contained an undigested fragment of peanut. The pathologist reported heterotopic gastric mucosa in the diverticulum and no evidence of acute inflammation.

This patient made an uneventful recovery and left the hospital on the thirteenth postoperative day. One month after operation his bowel habit was regular and he was free of pain A gastrointestinal series revealed a normal flow of barium through the small bowel.

COMMENT

Operations on Meckel's diverticulum are usually performed for the complications that so frequently accompany its presence. Obstructive bands; bleeding, massive or intermittent; ulceration; localized peritonitis; a strangulation producing gangrenous volvulus; malignant lesions and carcinoids, giving rise to intussusception, perforation, and hemoperitoneum; foreign bodies, and jejunal fistulas have all been reported and operated on. In the absence of such complications a so-called "silent" diverticulum generally remains in the patient's abdomen as a harmless pouch of small bowel, and may be detected for the first time at a routine postmortem examination.

The apparently normal Meckel's diverticulum discovered when operating for other disease should not, however, be left in the abdomen. In addition to the threat of complications the diverticulum may, without any complications or inflammation, act as a receptacle for food, other particles or barium, and produce symptoms of retention. This clinical picture is well known in the case of esophageal diverticulums but it is seldom thought of in connection with Meckel's diverticulum. The symptoms produced by the noninflamed, retentive type of Meckel's diverticulum are vague abdominal pain after meals, flatulence, and a feeling of fullness after meals. This is the only type of Meckel's diverticulum which can be demonstrated roentgenographically. In order to be visualized, the diverticulum must have a small opening otherwise it will empty too readily. If, on the other hand, the opening is too narrow it

may be closed off by inflammation and the diverticulum will not fill at all. In the patient reported here, as well as in several others in whom a pathologic examination of the diverticulum was made, no infiltration of inflammatory cells such as is seen in acute appendicitis was found in the walls of the diverticulum.

Even when Meckel's diverticulum is well demonstrated on the roentgenogram it will frequently be mistaken for a loop of small bowel. The appearance of the shadow that leads to the detection of Meckel's diverticulum is rather characteristic. The following varieties have been observed: (1) the "snake head" type having a pear-shaped "head" with a narrow constriction at the "neck," or a long, thin "head" with wide constriction at the "neck" *(2, 6);* (2) the "glove finger" type which is a uniformly thick, usually curved protrusion that shows no constriction *(17);* and (3) the "cherry on a stalk" type which has a long constriction near the tip with the lumen narrowed down to a thin line and a heavy, well-outlined bulbous tip *(4).* It is characteristic for all three types to show an angulation of the small intestine at the base of insertion of the diverticulum; in addition the tip or "head" will always point downward.

Numerous suggestions have been made as to the best way to demonstrate this anomaly. These include taking all roentgenograms with the patient in the supine and prone position and creating a continuous flow of barium by administering repeated small doses of a barium-water mixture *(16).* Retrograde demonstration by barium enema has been recommended if the ileocecal valve is patent *(5).* Butler et al. *(17)* recently noted the more frequent visualization of normal appendixes with the use of sodium carboxylmethyl cellulose as a suspending agent for barium sulfate. This may be helpful in visualizing Meckel's diverticulum as well. Be that as it may, the anatomic structure and position of the diverticulum will probably still determine whether it will, by its ability to retain barium, be demonstrated or not. With a more careful study of the small intestine and the knowledge of its roentgenographic appearance more diverticulums should be diagnosed.

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A Maxillomandibular Relationship Detector

Pierre O. Evans, *Lieutenant Colonel, DC, U. S. A.* (1)

THE device described herein is not a panacea for the establishment of horizontal and vertical maxillomandibular relationship in full denture prosthesis, but rather is an aid to the existing measurement technics. It uses the central bearing-point screw for the maintenance of the final determined vertical dimension and for scribing the intraoral Gothic development of centric relation, and giving an extraoral visualization of this measurement.

The *advantages* offered by this type of device are:

1. The recording plate does not have to be drilled or indented to indicate the centric point, thereby reducing the need for frequent replacement of these plates.

2. The patient's voluntary return to centric relation is easily checked extraorally without heavier displacing apparatus such as is found in other intra-extra-oral recorders.

3. A constant extraoral visual check is maintained during the entire set of the plaster check bite which obviates any chance of the patient slipping from centric relation.

4. The apparatus (fig. 1) can be assembled easily, is inexpensive, and consists of (1) 2 flashlight batteries wired and soldered in series, (2) a flashlight bulb or comparable lamp, (3) a box with a removable plastic or glass front to contain the batteries and bulb, (4) .2 wire leads with nipples for attachment to the central bearing point and recording plate, and (5) 2 stiff metal plates cut in arch forms with narrow extension arms 2 or more inches long, these arms being bent on themselves at the end and drilled so as to receive the wire nipples. (One plate is drilled through the center and a nut is soldered over it, the corresponding bolt or bearing point being about 1 inch long and tapered to a fine round point.)

(1) Madigan Army Hospital, Tacoma, Wash.

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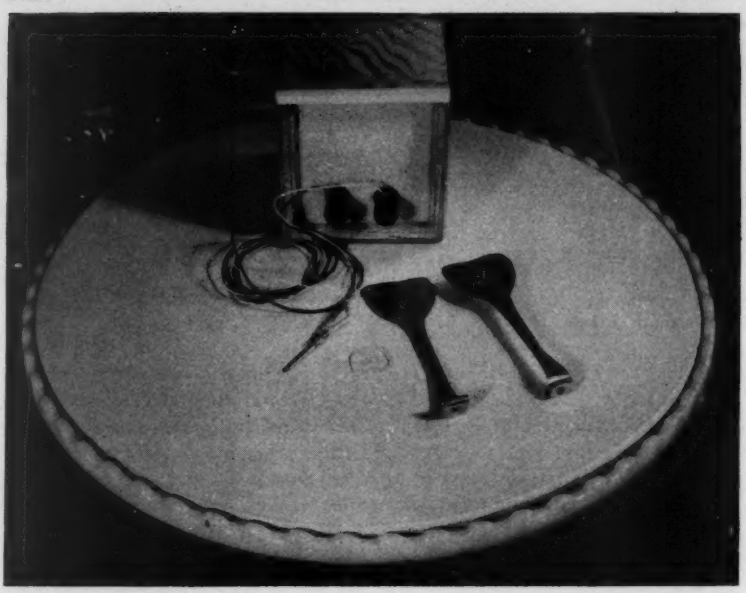

Figure 1.

Figure 2.

The *technic* for using this device, after vertical dimension has been determined and the wax occlusal contour rims have been trimmed to that dimension, is as follows:

1. The metal plate on which the tracing will be recorded is waxed into the upper rim so that its surface is horizontal and nearly flush with the occlusal plane. The extension arm is placed so that it is on one side of the midline, to prevent later interference with the incisal pin of the articulator in mounting the occluded casts on the articulator.

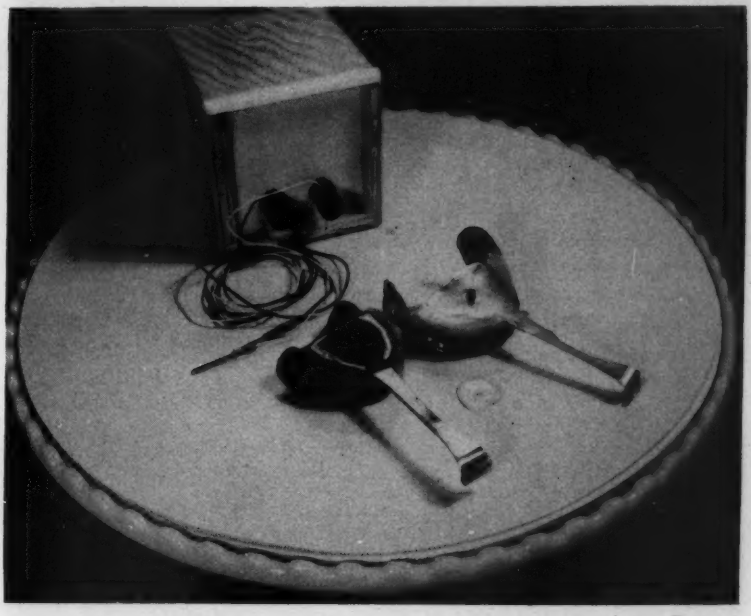

Figure 3.

2. The plate containing the bearing-point screw is waxed into the lower contour rim at least 2 mm. below the established occlusal plane in such a fashion that the point is centrally located in the arch, or about equidistant from the cuspid areas on one side, to the retromolar pads on the other side. The lower extension arm is also placed to one side of the midline so as to match the position of the arm on the upper rim (fig. 2). Parallelism of the arms in a horizontal plane when placed in the mouth indicates the same relationship of the recording plate and scribing point intraorally.

3. The bearing point is adjusted to the recording plate so that the occlusal contour rims remain in slight contact. From 1 to 2 mm. of wax are removed from the lower contour rim to obviate interference of

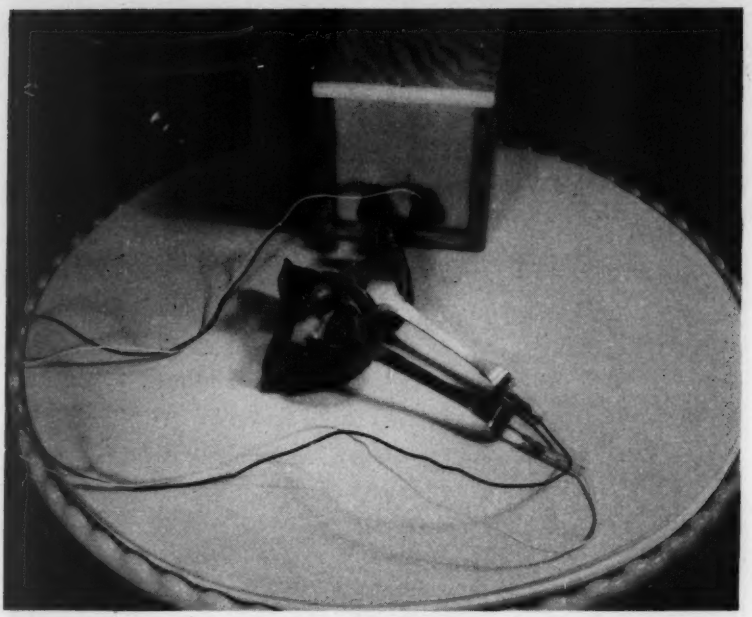

Figure 4.

movement in the excursions of the jaw. The upper rim is not trimmed because it indicates the angle and length of the upper teeth.

4. With the vertical dimension maintained solely by virtue of the central bearing point, the rims having been inserted, the patient is instructed to move into protrusive, right and left lateral excursions, returning to a central position between each movement and keeping the bearing point and recording plate in contact throughout. After doing this several times, until the operator is satisfied that the posterior triangular portion of the mandibular envelope of movements is being accomplished sharply with a minimum of strain by the patient, the rim containing the recording plate is removed and smoked by holding it over a small pledget of cotton that has been soaked in eugenol and ignited. The rim is returned to the mouth and the patient again goes through the three prime mandibular excursions. From these movements a Gothic arch or type of arrowhead tracing will be developed. At the apex or trisection of the developed lines is the centric relation point of the mandible to the maxillas (fig. 3).

5. The portion of the recording plate not involved in the tracing is wiped free of the oily smoke and a 1/16-inch acrylic resin shim with a hole just large enough to accommodate the tip of the central bearing point is placed so that the hole is over the scribed centric point. This

shim is waxed to that position with sticky wax and the rim returned to the mouth (fig. 4).

6. The patient is told to close lightly into contact with his back teeth. Lead wires from the detector box are inserted into the extension arm. If the bearing point entered the shim hole, metal to metal contact results in the bulb in the detector box lighting (fig. 5). Plaster is introduced between the plates, locking them in centric position.

Holding continuously into centric relation and established vertical dimension will keep the light illuminated. This is important during the plaster check period in which any deviation by the mandible from the recorded measurements will be reflected unfavorably in either the trial setup of the teeth or in the finished dentures.

CONCLUSIONS

From a psychologic viewpoint, this device stimulates the interest of the patient by making him a participant in the construction of his dentures. For the physically or mentally ill patient whose cooperation is poor, the presence of a definite visual goal stimulates greater cooperation with the dentist. From the operator's point of view, the detector light cuts out one more blind approach to final measurement of horizontal and vertical measurement and aids in the definite control of the

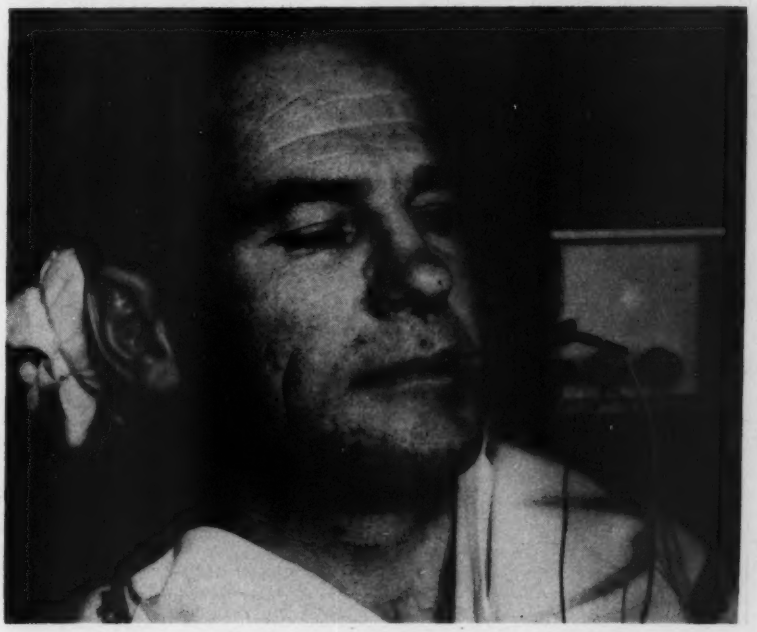

Figure 5.

mandible in establishing and maintaining these dimensions. In addition, a centric point can be established and easily held in the edentulous patient who, because of traumatic injury, previous malocclusion, or lack of cooperation, cannot accurately control or easily repeat his mandibular excursions. This technic has been used in the construction of over 150 dentures. In no case has it been necessary to remake or reset teeth because of an incorrect maxillomandibular registration.

Combat Exhaustion[1]

Albert J. Glass, *Colonel, MC, U. S. A.* [2]

THE TERM 'combat exhaustion' is applied to the well-known acute psychiatric battle casualty to designate a temporary psychologic failure of the soldier to function adequately in a combat situation. The manifestations of combat exhaustion are diffuse and may involve both the psychic and somatic spheres. Characteristically the signs and symptoms are quite variable. The clinical findings may change in a matter of hours or from day to day. In many patients they are mild, as exemplified by those persons who only verbalize the subjective sensations of fear in battle with no objective evidence of anxiety. In others tearfulness, depression, gross tremulousness, or hysterical blindness or paralysis may occur. A smaller group of patients exhibit such a severe disruption of personality function that they are out of contact with their environment and present a transient psychotic syndrome.

The acute mental breakdown of combat is an age-old phenomenon. Even the Bible records the panic and paralyzing fright of participants in battle. It has always been considered good military strategy to weaken and disorganize the enemy by using the crippling effects of fear stimuli. The use of bugles, cymbals, and whistles as currently employed by the Chinese troops is an ancient maneuver of this type. Indeed, the walls of Jericho were figuratively, at least, disintegrated by the blowing of trumpets. In modern warfare, artillery fire and air attacks are the most prolific producers of fear as well as actual battle casualties. It is an old military axiom that one never wastes artillery shells so long as they are hurled at the enemy. Even animals use fear-producing tactics, as exemplified by the roaring of the lion which renders the victim helpless before the actual attack.

It is evident that any method designed to increase the strength and number of fearful stimuli may serve to undermine the ability of persons to react aggressively to a source of danger. This occurs because the subjective sensations of fear are never helpful to the person but are painful. They make it difficult for him to think logically, and operate

(1) Adapted from paper published in the Surgeon's Circular Letter, June 1951.
(2) Psychiatric Consultant, General Headquarters, Far East Command.

to inhibit physical activity. Only the physiologic concomitants of fear are valuable in that they prepare and support the soldier for the increased bodily demands required for fight or flight.

The emotional overtones inherent in the words used to label the combat psychiatric casualty are of major importance. They affect the attitude of the patient towards his condition as well as influence the opinion of his fellow soldiers, friends, and family. Prior to the advent of modern medicine, the emotional upheaval in battle was designated by lay terminology indicative of paralyzing fear or flight with the moral connotation of cowardice.

Only since World War I has military medicine been called upon both to prevent and treat psychiatric casualties in an effort better to conserve the fighting strength. Because the greatest fear and casualty-producing agent was artillery fire, mental breakdown in battle became known as "shell-shock." This term, although descriptive, was unfortunate because it produced confusion and unclear thinking on the part of the patient and the physician. Medical officers debated amongst themselves as to the amount of brain damage present because of the inevitable history of a nearby explosion. Patients were easily influenced to believe then, as today, that their symptoms were a logical result of an outside force which caused irreparable injury to the mind. They readily took the view which removed personal responsibility for an emotional conflict. The entire syndrome was fostered and fixated by prolonged hospitalization with subsequent evacuation to the zone of the interior. Following World War I, it became generally recognized that shell-shock was primarily a psychologic problem, and that the effect of air blast on the head could not explain most of the immediate symptoms and all of the later persistent illness.

At the outset of World War II, the pendulum had swung completely to the view that the emotional disruption occurring in battle was an acute traumatic neurosis and should be classified accordingly. As a result, in the early phases of World War II, psychiatric casualties were designated as "psychoneurosis, anxiety state," "anxiety reaction," "psychoneurosis mixed," "conversion hysteria," et cetera. This nomenclature, like "shell-shock," proved to be misleading to the medical officers and traumatic to the patient. It unnecessarily conferred the diagnosis of a fixed neurotic disease on a fluid and transient emotional disorder. Again, it influenced the psychiatric casualty to believe he was suffering from a serious mental illness for which there was a poor prognosis and in which he could readily use the mechanism of secondary gain to transfer responsibility for his symptoms and behavior to the workings of his unconscious mind.

A new diagnostic category was needed. In 1943, the designation "combat exhaustion" was originated to convey a more realistic appreciation of a transient psychologic breakdown caused by battle stress, which might occur in persons with or without neurotic predisposition.

The word "exhaustion" gave the connotation of a logical result of combat from which one can recover by such ordinary means as rest and recuperation. This diagnosis quickly became popular and was adopted by all branches of the service with such modifications as "combat fatigue," "flying fatigue" and "operational fatigue."

After the initial confusion of the Korean campaign, "combat exhaustion" became the standard diagnosis to categorize the acute psychiatric casualty among divisional or other troops in the forward areas, but other definitions have already begun to creep in and distort the original meaning of the term. On the one hand, some have reverted to the past and regard combat exhaustion as a fancy name for being cowardly or yellow; on the other, it has become confused with physical exhaustion and considered an organic disease. My purpose in this article is to clarify the concept of combat exhaustion and to explain its complex cause which may include physical factors. It is hoped that a better understanding of the problem will point to logical methods of prevention and early treatment which are essential to conserve the fighting strength of our troops.

It has been stressed that the instinctive fear of the loss of one's life is the primary or basic cause of combat exhaustion. This is too simplified a concept and is similar to considering that the tubercle bacillus is the cause of active tuberculosis. As in tuberculosis, it should be recognized that there are multiple causative factors, such as the amount and intensity of the dosage of the traumatic agent, and the lowering of sustaining powers against illness, called resistance. These are of far more importance in producing the clinical disease than the ubiquitous fear of death in battle, which, like the germ of tuberculosis, is present in almost everyone.

When attention is shifted from the threat to life as the major cause of combat exhaustion to an examination of individual susceptibility and the sustaining powers which prevent fear from overwhelming the person, a new way is open for a more fruitful understanding of the entire problem. In considering individual susceptibility to emotional breakdown, it must be conceded that all persons do not have the same capacity of adjustment to stressful situations. In combat, it is particularly necessary that the soldier be able to mobilize and externalize aggression, in order adequately to cope with the enemy. The timid, passive person who has never had a fight and who rarely fires his rifle is especially vulnerable to fear because he is unable to discharge tension by hostile action. Consequently, anxiety builds up rapidly and becomes uncontrollable. To a lesser degree, the overly careful or overly aggressive soldier is more susceptible to combat stress because such character traits have been developed as a protection against excessive inner feelings of insecurity and dependency. Continuous combat produces a collapse of the soldier's hitherto effective defenses with the consequent rise of unbearable tension.

Another component of the personality which contributes to the adjustment of the combat soldier, is the conscience. This is that well-known internal policeman that forces one to perform unpleasant, distasteful, and even dangerous tasks, because of duty, honor, self-esteem, and self-respect. Persons with an average degree of conscience are internally compelled to keep going on in battle despite terror and a wish to flee or be helpless. Self-esteem is a potent force in human behavior and is deeply ingrained in our western population. It is responsible for the phrase, "I have to live with myself." If the strength of the conscience is low, the soldier lacks an internal compelling agent and more readily allows himself to be overcome by external stress. If the conscience is overly severe, it punishes the person for even the unavoidable disastrous episodes so common in battle. This reaction is frequently observed in officers and noncommissioned officers who blame themselves for the normal vicissitudes and casualties among their men, despite the intellectual knowledge that such events are inevitable in combat. This feeling of guilt adds a further burden to the existing tension and may precipitate a mental breakdown.

The omnipresent fear of death and the individual susceptibility to combat stress are not sufficient to explain the causation in most patients with combat exhaustion. It is common knowledge that some combat units consistently have fewer psychiatric casualties than others, despite an equivalent or greater degree of battle stress. This discrepancy in psychiatric rates can be observed among the various units of a battalion, a regiment, or a division. The distribution of vulnerable persons is similar in all organizations and does not explain the disproportionate incidence of psychiatric breakdown. Another factor must be present, namely, the influence of the group or combat unit which can offer realistic protection against external fear. The soldier does not fight alone--around him are his buddies who share his dangers and deprivations and will aid him if he is disabled. The more confidence he has in his platoon or company the less fearful is the battle situation. When men fight together and share common tribulations, they become bound by the closest of emotional ties. This affection, which is akin to love, serves to lessen concern for one's own life, thereby decreasing the crippling subjective sensation of fear. That such an emotional bond is common has been demonstrated by numerous instances in which soldiers have unhesitatingly performed dangerous and heroic deeds to save their friends. The grief reaction of a man who loses a buddy in combat is only comparable to the mourning over the loss of a loved one. The close kinship of man forged in battle is responsible for instances in which soldiers prematurely leave the hospital or a rear assignment to rejoin their comrades.

Group identification begins in training. Here the soldier gains not only competence and confidence in the use of his weapons but also learns the value of team work in battle: The foundation for the protective functioning of the unit. If additional training is given to replace-

ments by the combat unit, this serves, rapidly and effectively, to integrate them into the group. Such a training policy has been successfully adopted by divisional units in Korea when the tactical situation permitted. This acts as an added environmental support often needed by susceptible persons to prevent an early breakdown in battle.

Even the timid soldier comes to feel secure by being in a powerful group and often assumes the aggressive attitude of the organization. The unwilling person with little internal compulsion for hazardous duty is literally forced to adopt the higher standards demanded by his fellow-soldiers. The combat unit develops its own special characteristics which are quickly adopted by the replacement and after a short time he talks and acts like any veteran member. In brief, the group offers protection against fear to the soldier and provides for his emotional needs, but demands that he give up personal desires and selfish considerations. In its simplest form, group identification is a matter of "united we stand, divided we fall."

The ability of a combat unit to achieve tactical success and to sustain its constituents against emotional breakdown depends entirely on its leader. Napoleon's dictum "there are no bad soldiers, only bad officers," points to the crux of the problem of morale and combat effectiveness. Because the company-grade officer lives in intimate contact with his men he plays a vital role in their motivation and group spirit, and is figuratively and literally a father figure. Like a good father he cannot be over-indulgent, but he must have a personal concern for the comfort and welfare of his men. Such a leader sets the standard and motivation for his organization by example and behavior. The poor combat leader is quickly recognized by his men for inapt tactical management, unfair treatment, and a callous disregard for their comfort and safety.

A member of an adequately led combat unit has an increased resistance to mental breakdown because of the emotional and actual support provided by the group. The failure of such an environmental support is the major cause for most cases of combat exhaustion. It explains the difference in psychiatric rates for various units, but, there are exceptions even in a well-led combat unit when unavoidable battle episodes occur and heavy casualties are suffered. The protection of the group is suddenly weakened or destroyed. It is, at such times, that combat exhaustion may occur in the more susceptible members of the unit if they are left to face their danger alone. There are also occasions when the death or other removal of a combat commander may cause a disruption of the group, with consequent mental breakdowns, especially if a new leader, a platoon sergeant, for example, does not arise promptly to assume command.

A minor but pertinent cause of combat exhaustion is a lowering of the physiologic state of the body. This occurs when men go without food and sleep for many days, or become afflicted with such intercur-

rent diseases as malaria, diarrhea, or hepatitis. A decrease in physical ability to function adequately makes it difficult for the soldier to continue his aggressive adaptation and to control subjective sensations of fear. If not corrected, it may operate as "the straw that broke the camel's back" in its action as a precipitating agent to produce combat exhaustion. Unit commanders are well aware of this problem and attempt to insure periodic rest from combat with an opportunity to obtain hot food and sleep. Often the unit commander and the battalion surgeon act together to give certain soldiers a 24-hour rest period at the aid station or some other suitable location.

The prevention of combat exhaustion must lie in the province of command. The medical officer has no inoculation against the virus of fear. Moreover, it is impossible to select only mature, aggressive, and well-motivated men for combat duty. The measures that will sustain the soldier from an emotional breakdown are identical with those required for a good tactical unit. The selection of capable combat leaders and the initiation and maintenance of group morale and motivation are the logical and profitable means of preventing the soldier from being overcome by battle stress.

The prevention of psychiatric casualties is a relatively simple process compared to treatment after the soldier has suffered a mental breakdown. This can be accomplished effectively and rapidly when the causes of combat exhaustion are understood and if there is a proper appreciation of the role played by the primary and secondary gain in illness. The primary gain in illness is readily recognized when one considers that sickness confers a gain of being helpless with an honorable reason for not fulfilling adult obligations. This explains the euphoria of soldiers who receive a minor battle wound. It accounts for the phrase "million dollar wound" which, in effect, places the soldier in a privileged status of being unavoidably removed from the difficult and dangerous job of a combat soldier. It is only after recovery from such a wound, when the soldier is ready for discharge from the hospital, that tension and anxiety appear coincident with the removal of the advantages of illness. Any type of disease may provide an element of primary gain for the patient. This is equally true in civil life where sickness is the best excuse for remaining away from work or onerous tasks. A primary gain from illness is also achieved by the psychiatric casualty. Hysterical blindness or paralysis on the battle field duplicate disabling conditions and force removal from the stressful situation. In patients suffering from wounds, diseases, and most of those with combat exhaustion, the primary gain is unconscious and not directly sought, but when the soldier uses the same symptomatology to avoid return to combat or to prevent reassignment to noncombatant duty, we note the phenomenon of the secondary gain in illness. It is an attempt by the person to retain his patient status by using a pattern similar to that which produced the primary gain. This is demonstrated by the wounded soldier who, on recovery, continues to have pain about

the site of injury or operation and the psychiatric casualty who maintains his tremor, headache, and tension even though far removed from battle. The longer the patient remains away from his unit, in time and distance, the more vulnerable he becomes to the fixation of secondary gain. He is removed from the sustaining influence of his organization and is no longer motivated by their attitude and standards.

The awareness of the factors of time and distance in the gain in illness mechanism can be effectively used in the treatment of combat exhaustion, particularly if that illness is viewed as a temporary disruption of the protective powers of the group or a lowering of resistance of combat stress by physical factors. In practice, the acute psychiatric casualty is readily salvaged, if, after a period of relief from mental and physical stress, he is promptly returned to his organization. This return contains the emotional support required to aid him in resuming his previous self-control. A treatment program which involves a 2 to 4-hour period of rest and rehabilitation within the division area has the advantage of keeping the patient near his group where time and distance are not sufficient to permit the transition from primary gain into chronic secondary gain. Patients with severe combat exhaustion, however, must be evacuated to rearward hospitals and given a more prolonged relief from battle. This is especially true when they have been in combat for many months and have lost most of the members of their original group. At this rearward level of treatment it is sound treatment to return the patient to some useful noncombatant job as soon as possible in order to circumvent the buildup of symptoms of secondary gain and to give the soldier an opportunity to feel that he is still an effective member of the Army. After several months of a rearward assignment, the former combat soldier often is ready to return to his original organization. Even the patients with the most serious exhaustion who are evacuated to Japan are salvaged for effective noncombatant duty by psychotherapy. In this form of treatment it is instilled into the patient that what has happened to him is a rational and logical series of events, that he cannot cling to the helpless state that originated in battle and that the overcoming of the neurotic mechanism is imperative to prevent a fixation of symptoms which would occur if he were returned to the zone of the interior. Such further evacuation tends to place an additional burden on the patient in that he must continue to have symptoms in order to explain to himself, his friends, and family the reasons for his failure. If the pattern of secondary gain is repeated often enough, he is rendered helpless for subsequent useful activity and there is produced the well-known querulous, irritable, neurotic war veteran.

What has been stated above in regard to the prevention and treatment of combat exhaustion can be applied with equal force to the emotional breakdowns in noncombatant units whether they be located overseas or in the zone of the interior. The factor of group identification which sustains a person against the deprivations and vicissitudes of

the environment operates in an identical manner in noncombatant organizations. Here also, leadership is important in the maintenance of unit morale. Similarly, the treatment of psychiatric patients from noncombatant units should be based on the principle of treatment near the location of origin, thus limiting the gain in illness.

SUMMARY

Combat exhaustion results from several factors, the most important of which is a decrease in the environmental support provided by the group or combat unit, permitting the soldier to be overwhelmed by external danger. The recognition of this concept facilitates a more rational application of the methods that can be employed in the prevention and treatment of this disorder.

The Effect of Confinement on Psychiatric Patients[1]

John R. Cavanagh, *Commander, MC, U.S.N.R.*

The Manual of the Medical Department of the United States Navy (paragraph 3326) requires that a Board of Medical Survey insert the following sentence in all its reports on patients in whom disciplinary action is pending: "It is the opinion of the Board * * * that disciplinary action is (not) likely to have a deleterious effect on his mental or physical health." The medical officer confronted with the need for making such a statement is frequently in a quandary in that he may have had little experience on which to base this statement.

A survey of the effect of confinement on patients with a psychiatric diagnosis was made at the U. S. Naval Disciplinary Barracks from 1 April 1948 to 1 April 1949. During that time 1,694 confinees were received. There was an average daily census of 691 with an average monthly admission rate of 81. During that year, 112 confinees, 6.6 percent of the total population, had psychiatric diagnoses. Of this number, 47 diagnoses were established before arrival at the institution and 65 were established after arrival as a result of the initial psychiatric interview. Although those confined for scandalous conduct were included in this group as psychiatric cases, there is doubt in many cases whether or not a psychiatric diagnosis was justified.

DESCRIPTION OF THE STUDY

In attempting to find some basis for comparison between the psychiatric group and the nonpsychiatric group, it was believed that the most objective method of evaluation would be on the basis of the work record and conduct record of the confinee. A more subjective method was the evaluation by the psychiatrists and other qualified members of the staff who saw the patients during this year of observation. In averaging the work reports, each work-report grade was given a weighted score. These figures were than added algebraically and an average was obtained. For this purpose, the following weighted scores were used: Excellent +2; Good +1; Fair -1; Poor -2.

[1] From the U. S. Naval Disciplinary Barracks, Portsmouth, N. H.

RESULTS

Psychoses. Eleven psychotic patients were detected during the year of this study. These were discovered early during the time of confinement and there were indications that the psychosis was present prior to admission to the disciplinary barracks. Most of them were discovered during the quarantine period. Eight had schizophrenia, 2 had psychoses with constitutional psychopathic inferiority, and 1 psychosis, unclassified. These constituted only 0.6 percent of the total population of the barracks, a much lower rate than for civil society or the military service as a whole. One man had previous treatment at the United States Naval Medical Unit, Fort Worth, Tex. None of the other patients had been previously hospitalized as psychotics. As soon as a diagnosis of psychosis was established the patient was transferred to a hospital equipped for the treatment of psychotic patients. This was also considered a desirable measure when the patient was thought to be prepsychotic.

Personality disorders. The diagnosis of a personality disorder was noted in the health record of 10 men prior to their arrival and was established in 30 men at the screening examination made at the disciplinary barracks. Almost without exception, these men made a satisfactory adjustment to confinement. Their work record was above average and their involvement in disciplinary difficulties was substantially the same as for the normal group (0.81 as compared to 0.77). These men were not seen oftener at sick call than the average inmate. A small number of this group tended to react more strongly than the average to lack of news or distressing news from home, but this tendency was not outstanding. In only 1 man of this group would it appear that confinement induced an aggravation of his condition. On 3 occasions during the year, as a result of news from home which indicated that his wife was being unfaithful to him, he became recalcitrant, threatened to escape, and became violently assaultive for short periods which were followed by restlessness, insomnia, and anorexia. With a minimum of psychiatric care, however, he returned to work and when last seen was making a good adjustment to confinement and was considered an excellent worker.

Constitutional psychopathic inferiority. The diagnosis of constitutional psychopathic inferiority was established in 13 cases before the man was sent to the disciplinary barracks. It was established in 16 cases at the screening examinations at the barracks. There was a marked discrepancy in both the work and disciplinary records of these two groups. This difference probably arose from the fact that the psychiatric staff of the disciplinary barracks had (1) more rigid criteria for this diagnosis, (2) a better chance for observation of the man, and (3) complete records of the confinee's past history. In both groups the disciplinary record was poor. The group of patients who were diagnosed at the disciplinary barracks had a good work record. The good work record should be credited to the sincere effort of the Classification Board to

find the job for which each man was best suited. The psychopath did not constitute a serious problem and adjusted to confinement.

Mental defectives. This diagnosis was made in 1 patient prior to admission and in 3 as a result of the screening examinations. One patient was sent to the United States Naval Hospital, Chelsea, Mass., for disposition because his deficiency was considered serious enough to impair his legal responsibility. The other 3 were retained in the disciplinary barracks.

Epilepsy. One patient with epilepsy was detected during the year. He was referred to a naval hospital for appearance before the Board of Medical Survey.

Psychoneurosis. The diagnosis of psychoneurosis was made only once during the year of study. This was a conversion hysteria which was present in a naval offender who felt that he was unjustly confined. He developed a rigidity in one of his legs after a rather trivial injury to it. All efforts to treat this patient in the disciplinary barracks were fruitless. He was transferred to a naval hospital where psychotic manifestations later developed.

Scandalous conduct. Except for the 3 men whose diagnosis of scandalous conduct was made after admission to the disciplinary barracks, the work and conduct records of this group was above average. These men were working and living together in a special detail, the nature of which was known to the other prisoners and duty personnel. It constituted, therefore, a group to which everyone was somewhat sensitized. For this reason, a good work record has added significance. The 3 men who were diagnosed after admission to the disciplinary barracks received this classification because of overt homosexual acts committed within the prison. The work record of this group often suffered because of their resentment at being segregated. Disciplinary infractions in the group were at a minimum because they were placed under a small detail of mature, especially trained guards. Prisoners who were confined on a scandalous conduct charge were usually not homosexuals in the true sense of the word. They were men who had been guilty of homosexual acts, either while drunk or when deprived of female companionship. Actually in most cases their preference was for heterosexual associations.

Control group. A group of 100 prisoners of similar age, military experience, and disciplinary status was selected at random for comparison with confinees with psychiatric diagnoses. The control group was confined to the institution during the same year and for about the same length of time. The average work record for this group was not as good as that of the psychiatric group, being +1 as compared to an average of +1.39 for the group with personality disorders and +1.22 in one group of psychopaths. The average number of times on report for the nonpsychi-

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atric group was 0.77 as compared to an average of 0.41 for the psychiatric patients.

SUMMARY

Emotional outbursts are common in men during confinement. It is important that the psychiatrist in a disciplinary barracks have sufficient experience to recognize the temporary nature of these outbursts and to enlist the cooperation of the staff in their early detection. By detecting the unrest and potential "blowing of the top," the psychiatrist can institute corrective measures and thus save the man from becoming involved in further disciplinary action. Prevention in cases of this sort is one of the primary functions of the psychiatrist.

Although this sample is relatively small, it would appear that the adjustment of the psychiatric patients to confinement was as good, if not better, than that of the control group. The psychopaths did not make as good an adjustment to confinement as did the group with personality disorders. This is understandable from the nature of their disability. The psychopath apparently accepts the inevitable when he is confined. He is not a serious source of disturbance within the institution and has only occasional periods of excitement. The commanding officer and all members of the staff of the institution at which these studies were made were cooperative and they understood the needs of the emotionally disturbed inmate. This facilitated the excellent adjustment of these men to their confinement.

CONCLUSIONS

Prepsychotic and psychotic patients should be transferred to a hospital and not retained in a disciplinary barracks. Persons with personality disorders tolerate confinement well. Psychopaths are not a problem if they are treated individually by a classification board. The orientation of the command to problems of psychiatry is an important factor in the good adjustment of psychiatric patients to confinement.

Malayan Filariasis

Incidence and Distribution in Southern Korea

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David R. Lincicome, *Major, MSCR, U. S. A.* (2)

THE investigation on which this report is based was made during the years 1942-1944 by the senior author under the leadership of Professor Harujiro Kobayashi. At the invitation of the latter, the junior author has undertaken the task of correlating and preparing the results for publication. This report constitutes the second of 2 communications on filariasis in Korea. In the first (3) it was reported that about 5,000 patients had been examined in Southern Korea and Quelpart Island for filariasis and that 604 of these were positive for microfilarias of the species *Wuchereria malayi*. This report is concerned with an analysis of the incidence and distribution of *W. malayi* as observed in Southern Korea.

PROCEDURES

Twenty-one small villages, randomly selected from 5 general areas in the southern portion of the Korean peninsula, and 4 villages on Quelpart Island were chosen for study. All villages with the exception of those on Quelpart Island were impartially selected without regard for endemicity of the disease. Endemicity of elephantiasis on Quelpart Island had previously been reported (4) as considerable in several villages along the coast, although the cause was not known. Members of the population in each village were chosen without regard to age, sex, condition, or whether they had then or previously a history of elephantiasis. Blood collections were made at night between 2000 hours and midnight. Blood smears were prepared for study and identification of microfilarias as described in the first communication.

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(1) Kasumigaura National Hospital, Tsuchiura, Japan.

(2) Newark, Del.

(3) Senoo, T., and Lincicome, D. R.: The presence of Malayan filariasis in Korea. Tr. Roy. Soc. Trop. Med. & Hyg. (In press.)

(4) Bun, J. C.: Study of endemic elephantiasis in Korea. II. Survey results in Saishu Island. J. Chosen M. A. 20 (8): 1426-1442, 1939.

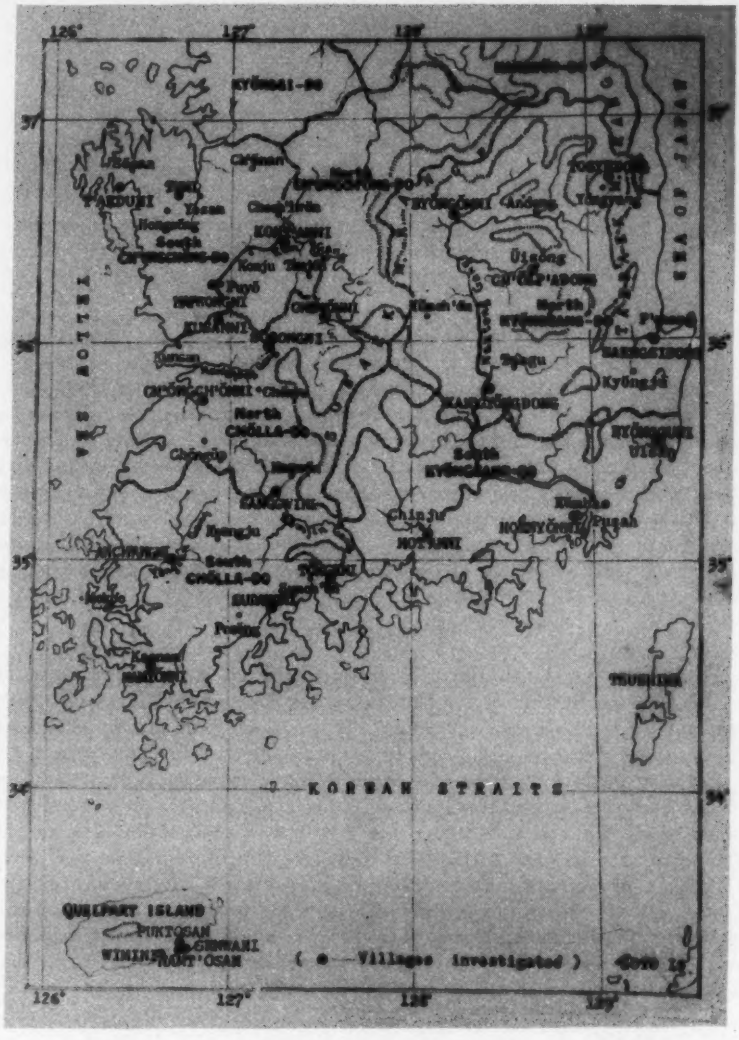

Figure 1. Map of Southern Korea and Quelpart Island.

PRESENTATION OF DATA

The geographic distribution of villages examined in shown in figure 1. The incidence of *W. malayi* on Quelpart Island is presented in table 1; in the southwestern part of the southern portion of the Korean peninsula in table 2; and in the southeastern section in table 3. The distribution of *W. malayi* by age groups and sex for Quelpart Island is shown in table 4 and for the Korean mainland in table 5.

DISCUSSION

The present study has revealed a high incidence of infection with *Wuchereria malayi* on the island of Quelpart off the southern tip of the Korean peninsula. The incidence of 26.6 percent in the 971 persons examined is well above that found for any other section of Southern Korea. The area beginning at Byongŏmni in North Kyŏngsang-Do and extending to Saengsidong on the east coast near P'ohang and Kan'gyŏngdong southward to the Pusan area is not so heavily infected, particularly in the area of the port of Pusan. In only one village (Togyedong) in the southeastern section was the incidence comparable to that found on the island of Quelpart.

The rate of infection in the 3 general areas of the southwestern sector was well above the rates observed for the southeastern section but was about half that for Quelpart Island. There was an apparent decline in incidence extending from the northern most area of South Ch'ungchŏng-Do to the extreme tip of the peninsula in South Chŏlla-Do. This is more readily appreciable when the range of incidence figures is studied and compared in each of the 3 main areas of this section.

Study of the distribution of *W. malayi* between the sexes reveals differences which may in part be explained on the basis of work habits rather than sex. On Quelpart Island where the women work in the fields as much or more than the men *(4)* the incidence of *W. malayi* was practically equal. In the southeastern section where there is a fairly low general level of incidence, there was a higher rate of infection in men than in women. Presumably here the men do more work in the fields and thus are more exposed to the bites of mosquitoes than the women. This difference is not apparent in the southwestern section where the general incidence was twice as great as in the southeastern part.

The general differences in sex distribution were carried over when incidence data were arranged along age lines. On Quelpart Island there was relatively little difference in incidence in either sex regardless of the age bracket. On the mainland, however, there appeared to be a prominent disparity between the sexes after the age of 20.

TABLE 1. *Incidence of* Wuchereria malayi *on Quelpart Island*

Village	Number of persons examined			Number positive for microfilarias			Incidence (percent)		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Namt'osan	258	130	128	80	41	39	31	31.5	30.5
Senwani	133	62	71	23	11	12	17.3	17.7	16.9
Puktosan	133	85	48	4	3	1	3	3.5	2.1
Wimini	447	308	139	151	100	51	33.8	32.5	36.7
Total	971	585	386	258	155	103	26.6	26.5	26.7

TABLE 2. *Incidence of* Wuchereria malayi *in Southwestern Korea*

Village	Number of persons examined			Number positive for microfilarias			Incidence (percent)		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
South Ch'ungchŏng-Do area:									
Kont'anni	102	58	44	26	17	9	25.5	29.3	20.4
Tuni	283	144	139	53	28	25	18.7	19.5	18
T'aeduni	196	95	101	13	7	6	6.6	7.4	5.9
Hapsongni	310	142	168	45	23	22	14.5	16.2	13.1
Total	891	439	452	137	75	62	15.4	17.1	13.7
North Chŏlla-Do area:									
Chewŏnni	191	102	89	26	17	9	13.6	16.7	10.1
Kusanni	155	96	59	19	13	6	12.3	13.5	10.2
Ch'ŏngch'ŏnni	198	104	94	9	5	4	4.5	4.8	4.3
Sanggwini	213	116	97	11	6	5	5.2	5.2	5.2
Sŏbongni	62	45	17	11	7	4	17.7	15.6	23.5
Total	819	463	356	76	48	28	9.3	10.4	7.9
South Chŏlla-Do area:									
Anch'angni	214	122	92	26	12	14	12.1	9.8	15.2
Sudangni	207	101	106	29	13	16	14	12.9	15.1
Namyŏnni	208	119	89	16	11	5	7.7	9.2	5.6
Tŏkengi	209	108	101	1	1	0	0.5	0.9	0
Total	838	450	388	72	37	35	8.6	8.2	9
Grand total	2,548	1,352	1,196	285	160	125	11.2	11.8	10.5

TABLE 3. *Incidence of* Wuchereria malayi *in Southeastern Korea*

Village	Number of persons examined			Number positive for microfilarias			Incidence (percent)		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
North Kyŏngsang-Do area:									
Byongŏmni	246	133	113	4	1	3	1.6	0.8	2.7
Togyedong	204	114	90	55	40	15	27	35.1	16.7
Ch'ŏlp'adong	182	91	91	0	0	0	0	0	0
Kan'gyŏngdong	201	107	94	0	0	0	0	0	0
Saensidong	169	79	90	1	1	0	0.6	1.3	0
Total	1,002	524	478	60	42	18	6	8	3.8
South Kyŏngsang-Do area:									
Byŏngguni	200	112	88	0	0	0	0	0	0
Hoenyŏnni	200	96	104	1	1	0	0.5	1.1	0
Hot'anni	80	43	37	0	0	0	0	0	0
Total	480	251	229	1	1	0	0.2	0.4	0
Grand total	1,482	775	707	61	43	18	4.1	5.5	2.5

TABLE 4. *Age group and sex distribution of* Wuchereria malayi *on Quelpart Island (villages of Namt'osan, Senwani and Wimini)*

Age group	Number examined			Number positive for microfilarias			Microfilaria rate (percent)		
	M	F	Total	M	F	Total	M	F	Total
0-10	68	44	112	21	15	36	30.9	34.1	32.1
11-20	197	153	350	66	48	114	33.5	31.4	32.6
21-30	83	40	123	26	12	38	31.3	30.0	30.9
31-40	44	29	73	10	6	16	22.7	20.7	21.9
41-50	44	29	73	11	9	20	25.0	31.0	27.7
51-60	38	29	67	12	10	22	31.6	34.5	32.8
61-80	26	14	40	6	2	8	23.1	14.3	20.0
Total	500	338	838	152	102	254	30.4	30.2	30.3

TABLE 5. *Age group and sex distribution of* Wuchereria malayi *in Southern Korea (villages of Togyedong, Kont'anni, Tuni, Hapsongni, Chewonni, Sudangni and Anch'angni)*

Age group	Number examined			Number positive for microfilarias			Microfilaria rate (percent)		
	M	F	Total	M	F	Total	M	F	Total
0-10	244	200	444	13	19	32	5.3	9.5	7.2
11-20	226	183	409	29	18	47	12.8	9.8	11.5
21-30	111	124	235	27	21	48	24.3	16.9	20.4
31-40	112	109	221	36	20	56	32.1	18.3	25.3
41-50	83	92	175	31	18	49	37.3	19.6	28.0
51-60	65	53	118	21	13	34	32.3	24.5	28.8
61-80	38	26	64	6	7	13	15.8	26.9	20.3
Total	879	787	1666	163	116	279	18.5	14.7	16.8

SUMMARY

Of 5,000 persons from 25 villages in Southern Korea and Quelpart Island examined for filariasis, 604 were shown to be infected with *Wuchereria malayi*. The highest incidence of the organism occurred in Quelpart Island, the next highest in the southwestern section, and the lowest in the southeastern area. The organism was equally distributed between the sexes on Quelpart Island and in southwestern Korea; men were more often infected in southeastern Korea.

The Treatment of Paroxysmal Ventricular Tachycardia With Pronestyl

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PROCAINE is known to be a valuable therapeutic adjunct in the management of certain cardiac arrhythmias, but such disadvantages as rapid hydrolysis in the plasma, the hypotensive effect, and moderate toxicity detract from its value. Related products have been investigated in the search for a more acceptable therapeutic agent. Mark et al. (2) has reported on the use of the amide of procaine (pronestyl) on ventricular arrhythmias. This was followed by further studies (3-5). From the observations of these workers, procaine amide hydrochloride is seemingly of definite value in the treatment of paroxysmal ventricular tachycardia and ectopic ventricular contractions. Kinsman et al. (5) considered it to be of some value in nodal tachycardia and ectopic auricular contractions. It was of no value in the treatment of chronic auricular fibrillation and auricular flutter. Kinsman et al. administered the preparation to 5 normal subjects and observed a slight fall in systolic blood pressure, no change in diastolic blood pressure and a slight increase in pulse rate. He also noted slight prolongation of the QRS complex and of the QT interval as well as transient T-wave changes which consisted of flattening, notching, or inversion.

(1) USAF Hospital, Lackland Air Force Base, San Antonio, Tex.

(2) Mark, L. C.; Berlin, I.; Kay, H. J.; Rovenstine, E. A.; Steele, J. M.; and Brodie, B. B.: Action of procaine amide on Ventricular Arrhythmias. Abstract of paper presented at meeting of the American Society for Pharmacology and Experimental Therapeutics, Indianapolis, Ind. Nov. 17-19, 1949. J. Pharmacol. & Exper. Therap. 98: 21-22, Jan. 1950.

(3) McCawley, E. L.; Stanwood, J. E.; and David, N. A.: Substitutes for procaine in ventricular tachycardia. Presented at American Physiology Society Meeting, April 17-21, 1950. Federation Proc. 9: 82, Mar. 1950.

(4) Elek, S. R.: Practical recognition and treatment of cardiac arrhythmias. Arizona Med. 7: 21-27, Oct. 1950.

(5) Kinsman, J. M.; Clay, H. L.; Coe, W. S.; and Best, M. M.: Procaine amide (pronestyl) in treatment of disorders of cardiac rhythm. J. Kentucky State M. A. 48: 509-511, Nov 1950.

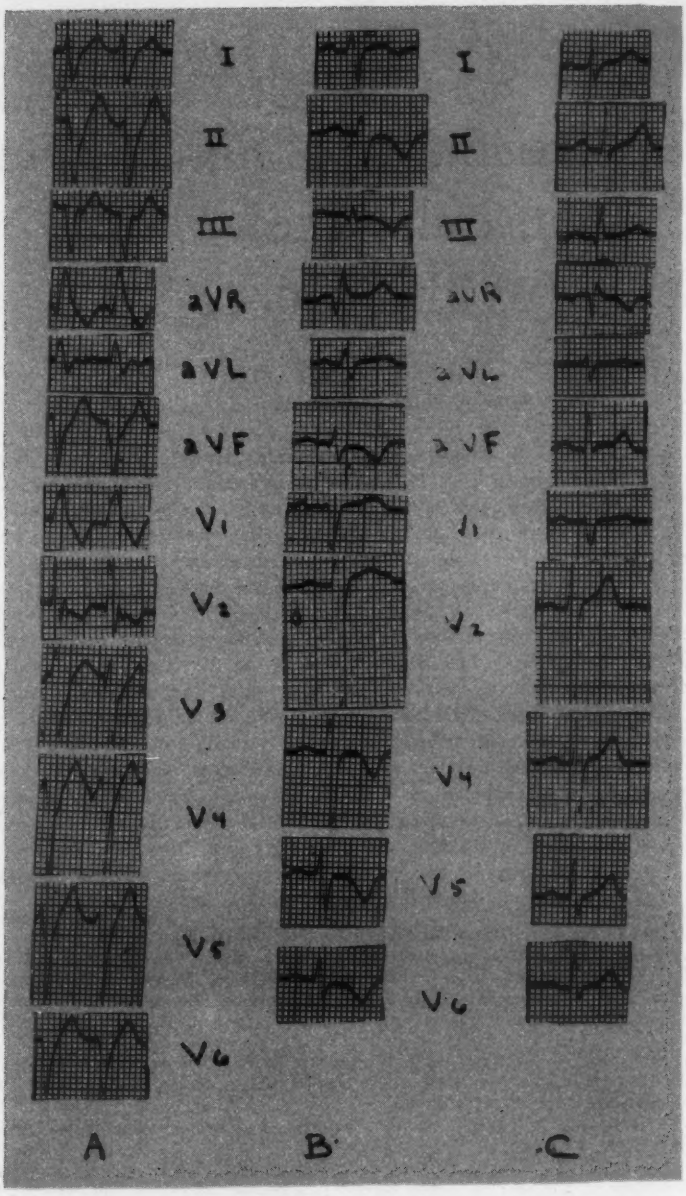

Figure 1. Representative portions of ECG tracings. (A) Before treatment. (B) Immediately after therapy with pronestyl. (C) Twenty-four hours after treatment.

CASE REPORT

A 33-year-old man entered the hospital complaining of "rapid heart," gaslike sensation of pressure below the heart, weakness, hunger, and moderate prostration which had been present for 23 hours. He had experienced several similar episodes since 1945 which varied in duration from 1 to 24 hours, and which were usually associated with periods of environmental stress. The details regarding treatment of previous episodes were not known but the patient thought that sedatives had been used with efficacy in the past.

Physical examination revealed an apprehensive man of stocky body build who was not in acute distress. The skin was flushed and moist. The blood pressure was 80/60 and the heart rate was 170. An ECG obtained at this time (fig. 1A) revealed a ventricular tachycardia originating from a single focus in the left ventricle.

Carotid sinus pressure failed to alter the rate or character of the ECG. A single oral dose of 0.1 gram of quinidine sulfate was administered and apparently well tolerated. Following this 0.4 gram was administered at 2-hour intervals for a total of 3 doses. Shortly after ingestion of the third dose the patient became moderately dyspneic and orthopneic. The respiratory rate was 40 and the pulse and apical rate 150. There was cyanosis of the lips and nail beds. The venous pressure was not clinically elevated, there was slight pitting edema in the lumbosacral area. The blood pressure was still 80/60, and scattered crepitant rales were audible in both posterior lung fields.

The patient was placed in an oxygen tent and the cyanosis disappeared rapidly, as did the obvious respiratory distress. Twenty cubic centimeters of a 10 percent magnesium sulfate solution was given intravenously to depress the myocardium. Depression so induced is not selective for heart muscle. Presumably as a result of giving this agent the apex rate decreased from 150 to 120. Following this 0.6 gram of quinidine was given by mouth at 2-hour intervals for 2 doses. Eight hours later and 36 hours after the onset of the paroxysmal ventricular tachycardia the apex rate had gradually increased to about 160; the general appearance of the patient was good; no lumbosacral edema was present and the cyanosis and respiratory distress had cleared up.

A 10 cc. ampule of pronestyl hydrochloride containing 1 gram of the procaine amide was diluted with 20 cc. of sterile water and injected intravenously at a rate of about 200 mg. per minute. During this procedure a continuous ECG was obtained (fig. 2). Progressive widening of the QRS complex and the QT interval with slowing of the ventricular rate to 110 was noted. At the point where 666 mg. of pronestyl had been given there was an abrupt restoration of sinus rhythm with an initial rate of 85. At the point of conversion of rhythm the patient stated that he had a strange sensation in his chest but was unable to further qualify this. One month after this medication he had had no further attacks of tachycardia. No maintenance dose of the drug was given.

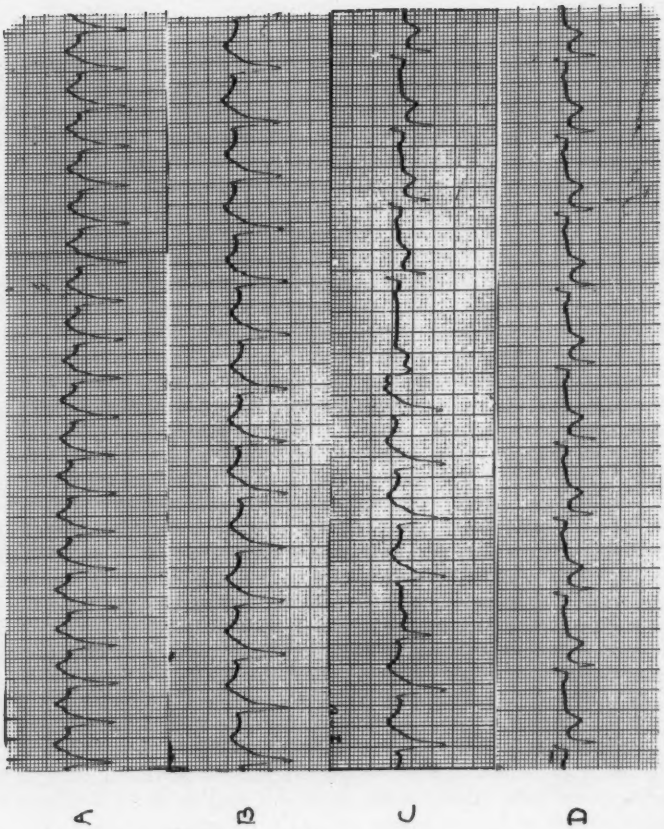

Figure 2. Representative portions of lead II. (A) During the initiation of treatment. (B) After having injected about 500 mg. of pronestyl. (C) Showing the abrupt change from ventricular to sinus rhythm. (D) Immediately following cessation of therapy.

DISCUSSION

It is probable that this patient had experienced similar episodes since 1945. His rhythm dramatically converted to a sinus rhythm while he was receiving procaine amide hydrochloride intravenously. Immediately following the rhythm conversion, there was slight depression of the ST segment and inversion of the T-wave (fig. 1B). The rather striking ST changes immediately following restoration to sinus rhythm persisted for several hours. Although T-wave changes of this nature have been reported as a pronestyl effect, in this instance it could represent myocardial anoxia secondary to the persistent tachycardia. The right axis deviation, wide S-wave in leads I, V_5 and V_6 with the wide R-wave in lead aVR suggest a right intraventricular conduction defect, which may represent pronestyl effect though, again, anoxia cannot be excluded. Twenty-four hours after conversion (fig. 1C) there was a decided shift in the axis toward normal. S_1 and R_{aVR} do not exceed 0.04 sec. and S_{V5} and S_6 are less than 0.04 sec.

CONCLUSION

Although no conclusions can be drawn from a single case, it is hoped that the addition of this case to the few previously reported will eventually aid in the full evaluation of this relatively new therapeutic agent.

Surgical Considerations in Sudden Cardiac Arrest

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SUDDEN cardiac arrest may develop in a heart that is relatively normal, especially during surgical procedures. Almost every institution that has a large surgical service is likely to experience one or more such cases each year. It is desirable, then, that the surgeon faced with the urgent and serious complication of cardiac arrest have in mind a definite plan for providing the most effective therapeutic measure possible. Three cases of sudden cardiac arrest have occurred at this hospital between September 1949 and May 1950. Consideration of these cases has stimulated us to formulate a coordinated plan for the treatment of possible future accidents.

CASE REPORTS

Case 1.—A 30-year-old man, presenting a deep, progressive, obstructive jaundice, was prepared for an exploratory laparotomy on 27 September 1949. Choledocholithiasis or carcinoma of the head of the pancreas was the preoperative diagnosis. He received 0.2 gram of pentobarbital sodium 80 minutes before anesthesia and 16 mg. of morphine and 0.4 mg. of atropine sulfate 50 minutes before anesthesia was induced. A Levine tube was inserted into the stomach shortly before the operation. At 0820 spinal anesthesia using 7.5 mg. of tetracaine hydrochloride, 112 mg. of procaine hydrochloride, and 0.5 mg. of epinephrine hydrochloride was induced. Fifty milligrams of ephedrine sulfate were given subcutaneously at the same time. Anesthesia was elicited to the level of the fourth thoracic vertebra in about 10 minutes. Within 10 more minutes a right subcostal incision was made. At that time it was noted by the surgeon, who called it to the attention of the anesthetist, that there was no bleeding from the skin or subcutaneous tissue. No pulse, respiration, or blood pressure could be elicited. A diagnosis of cardiac arrest was made. An anterior chest incision was immediately made over the left sixth interspace. The fifth and sixth cartilages at the costochondral junctions were cut and manually retracted,

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making an adequate and rapid approach to the heart. On exposure the heart was flaccid and dilated, and there was no motion. The heart was grasped between the thumb and forefingers and massaged about 100 times per minute for 3 minutes. During this time a peripheral blood pressure of 80/60 was maintained. Two cubic centimeters of a 1 percent solution of procaine hydrochloride was introduced into the ventricular myocardium and 3 cc. of a similar solution was introduced into the pericardial sac. Almost at once the heart began spontaneous, rhythmic contractions of good strength.

Intermittent, artificial, positive-pressure oxygenation was maintained with an endotracheal tube which had been introduced when the chest was opened. This was continued for 1 hour after the detection of cardiac arrest. Two hundred cubic centimeters of a 25 percent solution of serum albumin was administered intravenously during the resuscitation to help maintain the circulating fluid volume and to decrease cerebral and pulmonary edema. It was estimated that the patient sustained a relative or total anoxia of about 9 minutes. It was less than 12 minutes before the patient re-established spontaneous cardiac action. The chest and abdominal skin incisions were closed about 1 hour after the diagnosis of cardiac arrest. Good cardiac action was observed for 25 minutes before the chest incision was closed. Electrocardiographic tracings (lead 3 only), taken about 50 minutes after the diagnosis of cardiac arrest, revealed inverted T-waves and a slurred QRS complex with regular sinus rhythm. Subsequent tracings showed a persistent inverted or diphasic T-3 with normal sinus rhythm. These findings were interpreted as insufficient evidence for significant myocardial damage. Within a few hours after his return to the ward, the patient developed progressive decerebrate rigidity, coma, and hyperpyrexia. He died about 40 hours after the cardiac arrest of cerebral damage and pulmonary edema.

A postmortem examination revealed (1) a carcinoma of the head of the pancreas obstructing the common bile duct; (2) extensive cerebral edema and congestion with generalized neuronal degeneration in the basal ganglia and medulla; and (3) postsurgical hemorrhagic pericarditis.

Comment.—The early detection of cardiac arrest is essential if successful treatment is to be accomplished. In this case it is highly probable that the cardiac arrest took place some time before the incision was made, because it was the surgeon and not the anesthetist who recognized the first signs of an accident. Had a qualified anesthetist been at the head of the table, the cardiac arrest might have been discovered several valuable minutes earlier *(2)*. Chapman *(3)* has suggested that in patients with deep jaundice, the presence of biliary products in the myocardium may increase the irritability of the heart and thus tend to facilitate the occurrence of cardiac arrest. When the

(2) American College of Surgeons: Manual of Hospital Standardization, 1946. pp. 44-46.
(3) Chapman, H. J.: Personal communication.

chest was opened it was noted that the heart was flaccid and still, which is characteristic of a vagal standstill. Here it might have been to advantage to have added epinephrine to the procaine solution that was introduced into the heart. This is a small point in this case because the heart began beating almost at once when massage was started but it might have been of great importance if the heart had been slow to respond. The most probable cause of the failure to save the patient was cerebral anoxia of too-long duration. Irreversible changes had taken place in the vital centers before the circulation could be reestablished. Delay in diagnosis and delay in opening the left chest and massaging the heart both contributed to the failure.

Case 2.—A 50-year-old man with a large mass in the right side of the abdomen, recent progressive jaundice, and intestinal obstruction, was prepared for an exploratory laparotomy on 9 December 1949. He was given 0.2 fram of pentobarbital sodium 1 hour before anesthesia, and 16 mg. of morphine sulfate and 0.5 mg. of atropine sulfate subcutaneously 30 minutes before anesthesia was induced. At 1000 he was given a spinal anesthesia of 150 mg. of procaine hydrochloride, 10 mg. of tetracaine hydrochloride, and 0.26 mg. of epinephrine hydrochloride. At 1010 anesthesia was recorded to the level of the seventh thoracic vertebra. The blood pressure was 110/60 and the pulse 118 at the time. At 1020, before an incision could be made, the anesthetist at the head of the operating table noted the absence of respirations, pulse, and blood pressure. A diagnosis of cardiac arrest was made. An endotracheal tube was inserted and intermittent, artificial, positive pressure oxygenation was begun. Within 3 minutes 0.2 mg. of epinephrine hydrochloride was introduced into the cardiac chamber through the chest wall; and the cardiac musculature was stimulated with a needle. There was no change in the patient's condition. By 1030, more than 10 minutes after the diagnosis of cardiac arrest had been made, the left side of the chest was opened and manual cardiac massage at a rate of 100 strokes per minute was begun. Ten cubic centimeters of a 1 percent solution of procaine hydrochloride were injected into the pericardial sac; and 3 cc. were injected into the myocardium. Weak, twitching motions of the myocardium were noted during the first 10 minutes after the chest was opened. Cardiac massage was continued for 50 minutes without any sign of recovery, and the patient was pronounced dead at this time.

Necropsy revealed carcinoma of the head and body of the pancreas with metastases to the abdominal viscera. No examination of the brain was made.

Comment.—Early and accurate diagnosis of cardiac arrest was made by the anesthetist, who also inserted an endotracheal tube and began intermittent, artificial oxygenation well in time for successful resuscitation. The surgical team failed completely to carry out, in any reasonable time, the only procedure that could have promised a chance for

the patient: thoracotomy and cardiac massage. Needling the heart through the chest while the precious seconds ticked away was a useless procedure, without justification. Irreversible damage to the central nervous system had doubtless taken place by the time thoracotomy and cardiac massage were finally done, more than 10 minutes after the diagnosis of cardiac arrest. Delay in cardiac massage through the left chest obviated any possibility of resuscitation in this case.

Case 3.—A 17-year-old boy, with a diagnosis of acute appendicitis, was prepared for an emergency appendectomy on the evening of 5 April 1950. He was given 0.1 gram of pentobarbital sodium orally, and 16 mg. of morphine sulfate and 0.4 mg. of atropine sulfate, hypodermically, 45 minutes before the operation. At 2115 spinal anesthesia was induced using 7.5 mg. of tetracaine hydrochloride, 112 mg. of procaine hydrochloride, and 0.5 mg. of epinephrine hydrochloride. At 2130 a right Rocky-Davis incision was made, and a recently perforated appendix was found. The base of the appendix was ligated and the mesoappendix was clamped within 30 minutes after the anesthesia was given. At this point the patient was heard to give a low moan, and the entire operating team noted that he had become pulseless and cyanotic. No blood pressure reading could be elicited. The drapes were immediately thrown back and an anterior chest incision made in the left third interspace. The heart was found to be perfectly still. Manual massage was begun, and within 10 seconds the heart began feeble contractions which rapidly became forceful. Positive pressure oxygenation at 12 mm. of mercury was begun before the chest was opened, but the patient recovered normal respiratory movements before an intratracheal tube could be inserted. The blood pressure was recorded as 100/50 five minutes after the arrest, and as 140/70 by the time the chest was closed about 30 minutes later. One gram of procaine hydrochloride in 5 percent dextrose solution in distilled water was given intravenously as the chest was being opened. The pulse, when the patient left the operating room at 2300, was 100 per minute and of good volume and force. The respirations were normal, and the diaphragmatic excursions were equal.

Two and one-half hours after he returned to his ward, the blood pressure was 128/78; the pulse was 124; and the respirations 24. The patient had reacted from the anesthesia by this time and seemed mentally clear. He was given 500 cc. of whole blood at this time. An electrocardiographic tracing, taken 20 hours after the arrest, revealed an inverted T-wave in lead CF-4 which was interpreted to be of minimal significance. A tracing, taken on the third postoperative day, revealed the same findings as the previous one. The patient remained clear mentally from the time he reacted from the anesthesia. He had amnesia only for the interval that he was unconscious. He developed an infection complicating his abdominal wound. This cleared satisfactorily and he was discharged from the hospital in good condition on the twenty-third postoperative day.

Comment.—An alert surgical team acted with dispatch at the first signs of cardiac arrest in this case. The heart was massaged before irreversible central nervous system damage could take place. Resuscitation was successful, and the patient made a complete recovery because the surgical team and the anesthetist carried out a planned, coordinated procedure swiftly and effectively.

DISCUSSION

Incidence.—A review of recent literature reveals that little work has been done on a statistical evaluation of the incidence of sudden cardiac arrest. Hamilton Bailey *(4)* in 1941 found only 50 cases reported since 1902. Ruzicka and Nicholson *(5)* reported 9 cases in a 5-year survey at the Lahey Clinic. Because many cases probably go undiagnosed or misdiagnosed, the incidence of sudden cardiac arrest may be higher than is indicated by statistics.

Diagnosis.—Early, accurate recognition of this condition, followed promptly by adequate therapeutic measures may be life-saving *(6)*. The anesthetist, at the head of the operating table, is the logical person to detect the first signs of cardiac arrest. It is imperative that a qualified anesthetist be present for all local, spinal, and intravenous anesthetics *(2)*. Cardiac arrest may be recognized by: (1) sudden imperceptible pulse; (2) labored respirations, which soon stop; (3) sudden cyanosis followed by a mottled, diffuse, ashen-gray color; (4) inaudible heart sounds; (5) widely dilated pupils; (6) imperceptible blood pressure; and (7) the absence of bleeding or pulsations at the operative site. Where possible, a direct writing electrocardiographic tracing would be of great value in determining the exact nature of the arrest.

The causes of sudden cardiac arrest are as follows:

1. Ventricular fibrillation is the commonest cause. Such as arrhythmia is thought to be most frequently encountered during the stages of light anesthesia, either in the first 30 minutes or during the recovery, when the myocardium is most irritable *(7)*. The ventricles pass into a state of incoordinate, ineffective, aimless twitchings. Ventricular fibrillation is caused by any influence that contributes sufficiently to the hyperirritability of the myocardium *(8)*, such as: (a) the epinephrine, which may be released during the excitement period of anesthesia

(4) Bailey, H.: Cardiac massage for impending death under anesthesia. Brit. Med. J. 2: 84-85, July 19, 1941.

(5) Ruzicka, E. R., and Nicholson, M. J.: Cardiac arrest under anesthesia. J. A. M. A. 135: 622-628, Nov. 8, 1947.

(6) Touroff, A. S. W., and Adelman, M. H.: Resuscitation after 40 minutes in cardiac arrest. J. A. M. A. 139: 844-847, Mar. 26, 1949.

(7) Lampson, R. S.; Schaeffer, W. C.; and Lincoln, J. R.: Acute circulatory arrest from ventricular fibrillation for 27 minutes, with complete recovery. J. A. M. A. 137: 1575-1578, Aug. 28, 1948.

(8) Best, C. H., and Taylor, N. B.: Physiological Basis of Medical Practice. 5th edition. The Williams & Wilkins Co., Baltimore, Md., 1950. pp. 238-239.

(9); (b) the parenteral administration of epinephrine and related amines in conjunction with cyclopropane, chloroform, or ethyl chloride; (c) thyrotoxicosis, with cardiac changes; (d) severe relative anoxia, such as may be seen with certain types of anesthesia *(8)*; (e) electric shock, such as electrocution, lightning, and certain small currents *(8)*; (f) trauma to the heart and chest wall, particularly associated with thoracic operations when a satisfactory depth of anesthesia has not been attained *(8)*; (g) ventricular paroxysmal tachycardia in which fibrillation may be a terminal event *(8)*; and (h) toxic doses of digitalis or quinidine *(8)*.

2. Reflex stimulation. A strong vagal reflex can depress all pacemaking stimulation and cause complete arrest of the heart. There are many such situations in which spontaneous recovery occurs; but reflex standstill, with the patient on the operating table, may be a more serious complication. Vagal standstill may be caused by: (a) stimulation of the vagus at the hilus of the lungs, along the esophagus, or trachea and in the bronchi, which may complicate operations and endoscopy *(6, 10, 11)*; (b) stimulation of a hyperactive carotid sinus *(10)*; (c) pulmonary embolus of fat or air; (d) increased vagal excitability from premedication, anesthesia, or relative anoxia *(7)*; (e) traction on the mesentery during an abdominal operation *(8)*; and (f) anoxia *(8)*.

3. Acute fulminating failure of the myocardium caused by myocardial ischemia as a result of sudden massive occlusion of a coronary vessel, or sudden myocardial depression from toxic drugs or drug idiosyncrasy *(10)*.

Prophylaxis.—Cutler and Zollinger *(12)* have aptly described the ideal circumstances for a satisfactory surgical risk as those that permit the patient to come to operation with his tissues properly hydrated, the food reserves in their normal status, the metabolism adjusted as perfectly as it may be, the intestines working normally, the circulation at its optimum efficiency, and the nervous system undisturbed and peaceful as in daily life. Certainly the good surgical risk, evaluated by these standards, will incur minimal danger from the possibility of cardiac arrest at operation. Moreover, the incidence of cardiac arrest might be reduced still further if the surgeon with the prevention of cardiac arrest in mind: (1) has a cardiologist evaluate the patient's cardiac arrhthymias and correct them if possible; (2) avoids giving toxic doses of digitalis, quinidine, and other drugs that increase myocardial irritability; (3) avoids giving combinations of drugs that act together to increase the tendency toward the development of cardiac arrest; (4) as-

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(9) The irritability thus produced prevails particularly when the myocardium has already been irritated by cyclopropane, chloroform, or ethyl chloride.

(10) Adriana, J.: Techniques and Procedures of Anesthesia. Charles C Thomas Publisher, St. Louis, Mo., 1947. pp. 141-153, 338.

(11) Mautz, F. R.: Resucitation of heart from ventricular fibrillation with drugs combined with electric shock. Proc. Soc. Exper. Biol. & Med. 36: 634-636, June 1937.

(12) Cutler, E. C., and Zollinger, R.: Atlas of Surgical Operations. The Macmillan Co., New York. N. Y. 1939. p. 13.

sures himself that the induction of and recovery from anesthesia takes place under as near ideal conditions as possible, avoiding disturbing noises, moving, jolting, and manipulation through the use of special induction and recovery rooms; and (5) avoids intubations under light anesthesia.

At the operating table it is our practice to put 1 gram of procaine hydrochloride in the bottle of intravenous fluids that is in use for patients undergoing major operations. This procedure may offer some protection against the development of cardiac arrhythmias during the operation. During chest operations it is desirable to infiltrate well the hilus of the lung with a 1 percent solution of procaine hydrochloride without epinephrine to further protect the vagi from disturbing external stimuli during the manipulations at that point.

Treatment.—The primary objective of treatment is the re-establishment of general circulation with resumption of oxygen exchange *(7)*. The urgency of this measure is obvious when the operator keeps in mind that the expermiental deadline for complete recovery of the central nervous system after failure of its circulation is 3 minutes and 10 seconds. After 8 minutes of circulatory failure and anoxia, there is almost 100 percent mortality. Patients who recover after 3 minutes and 10 seconds of total cerebral anoxia are likely to show gross personality and central nervous system defects *(13)*. Relative anoxia may allow a longer period before irreversible changes take place; but if the patient is in poor physical condition, the tolerance of the central nervous system may be diminished and allow irreversible changes much sooner. At operation it is not possible to estimate accurately either the patient's tolerance to, the duration of, or the degree of relative anoxia. When the diagnosis of cardiac arrest is made, the following therapeutic measures should be initiated without delay:

1. The anesthesia is discontinued and an endotracheal tube is inserted if one is not already in use. Oxygen is administered at a positive pressure of not more that 12 mm. Hg. at a rate of from 20 to 24 cycles per minute. This is continued until the patient again breathes spontaneously *(6, 14)*. Beck and Rand *(15)* suggested the use of a mechanical breathing machine as an important aid in effecting successful artificial respiration over a long period of time and recommended that every operating room have such a machine. The Bennet breathing machine is available in our operating room for respiratory emergencies.

2. The patient is placed in the Trendelenberg position.

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(13) Weinberger, L. M.; Gibbon, M. H.; and Gibbon, J. H., Jr.,: Temporary arrest of circulation to the central nervous system; physiologic effects. Arch. Neurol. & Psychiat. 43: 615-634, Apr. 1940.

(14) Stage, J. T.: Cardiac arrest under anesthesia. South. M. J. 42: 597-603, July 1949.

(15) Beck, C. S., and Rand, H. J., III: Cardiac arrest during anesthesia and surgery. J. A. M. A. 141: 1230-1233, Dec. 24, 1949.

3. Cardiac massage is performed as quickly and effectively as possible, and the only satisfactory entry for this massage is through the left thoracic wall. If the left side of the thorax is open when the heart stops, massage can be executed quickly and effectively (7). The heart is grasped gently and firmly with the right or both hands. A rhythmic, milking massage from apex to base, is begun and continued at the rate of at least 100 per minute (16). A systolic pressure of from 60 to 80 mm. Hg., measurable in the peripheral arteries, can be maintained with proper massage (6). With the chest open, the heart can be seen to be either in complete standstill or in a state of ineffective motion; and the type of arrest can be determined (7,14). When ventricular fibrillation is present, 10 cc. of a 1 percent solution of procaine hydrochloride is introduced into the right auricle and massaged throughout the cardiac chambers; and 5 cc. of the same solution is placed in the pericardial sac (17). Massage is continued. If any motion is discernible, epinephrine is contraindicated because this drug tends to potentiate the arrhythmia. If the heart is motionless, 10 cc. of a 1 percent solution of procaine hydrochloride with 0.25 cc. of a 0.1 percent solution of epinephrine hydrochloride is introduced into the right auricle and massaged throughout the cardiac chambers. Five cubic centimeters of a 1 percent solution of procaine hydrochloride is placed in the pericardial sac (14,17) and massage is continued. If the heart does not respond, another injection of the epinephrine-procaine mixture is given.

If the left side of the chest is not open at the time the diagnosis of cardiac arrest is made, it should be opened without delay (16). Surgical draping and preparation of the skin must be minimal or disregarded. The chest is opened as rapidly as possible by an adequate incision along the left fifth interspace anteriorly cutting the cartilages at the fifth and sixth costochondral junctions. The therapy should then proceed as described.

4. In ventricular fibrillation simple mechanical irritation is frequently sufficient to restore a normal supraventricular rhythm, but if the normal sinus rhythm is not restored in a reasonable time by the use of massage and procaine, defibrillation may be accomplished by the use of electric countershock. This procedure is accomplished by placing the heart between two large, bare, noncorrosive metal electrodes which should measure 6.35 cm. in diameter on the contact surface (15). The heart is momentarily (0.1 to 0.5 seconds) subjected to a 110-volt, 60-cycle current of 1.5 amperes between the electrodes by a suitable electronic apparatus. Usually a series of such shocks is necessary to produce defibrillation. When this treatment is successful, the ventricles cease fibrillating and remain in standstill momentarily before a supraventricular rhythm is established. Massage is again continued until the vigor of the heart-beat is sufficient to empty the car-

(16) Johnson, J., and Kirby, C. K.: Experimental study of cardiac massage. Surgery 26: 472-478, Sept. 1949.

diac chambers (17). Beck and Rand (15) described a combination suction cup and electrode machine which they claimed permits more rapid filling of the heart and thus an increased output during massage as well as defibrillating shock if needed. Such a device would be a desirable refinement in the operating room.

A current of 0.4 amperes will produce ventricular fibrillation when applied across the hearts of animals experimentally, but currents of 0.8 amperes and over will suppress fibrillation. The large area of the electrodes is designed to protect the heart musculature from electroshock damage, since an electrode of small surface area or a needle would produce a burn (11).

5. At the time of diagnosis 10 cc. of a 1 percent solution of procaine hydrochloride is given intravenously. This seems to offer protection against the predisposition to ventricular fibrillation and arrhythmia during anesthesia (6,7).

6. A large-bore needle should be in place in a suitable vein, or a large-bore, cut-down cannula should be put in place if this has not already been done (7,10,14). The intravenous input should be kept open by a slow drip of 5 percent dextrose in distilled water in case it becomes necessary to give blood or other fluid to help maintain adequate volume in the general circulation. Human serum albumin should be readily available because of its beneficial influence in decreasing cerebral edema.

7. A direct-writing electrocardiographic tracing should be taken continuously as an aid in evaluating the cardiac rhythm during the diagnosis, treatment, and follow-up (7).

8. The heart is observed for at least 20 minutes after re-establishment of spontaneous rhythm before the chest is closed. Antibiotics are introduced into the pericardial and pleural spaces to counteract infection. Electrocardiographic tracings, antibiotics, control of fluid balance directed toward preventing cerebral and pulmonary edema, and careful observation should be included in the general postoperative care.

Prognosis.—Recovery and the amount of irreversible change that remains are directly related to the duration and the degree of relative anoxia that the central nervous system has sustained. Thus the prognosis is directly proportional to the efficiency, speed of diagnosis, and treatment. Bailey reported the survival and complete recovery in only 4 of 40 patients that he had massaged (4). Ruzicka and Nicholson report complete recovery in 3 of 9 patients so treated (5).

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(17) Beck, C. S.; Pritchard, W. H.; and Feil, H. S.: Ventricular fibrillation of long duration abolished by electric shock. J. A. M. A. 135: 985-986, Dec. 13, 1947.

CONCLUSIONS

In the surgical management of patients with cardiac arrest a coordinated plan of therapy is essential. Early and adequate oxygenation of the general and cerebral circulation must be maintained until the patient's heart is able to beat spontaneously. Immediate thoracotomy with actual visualization of the heart and manual cardiac massage is necessary if irreversible damage to the central nervous system is to be avoided. The use of procaine hydrochloride, introduced into the right auricle and pericardial sac, is advised in the treatment of a cardiac arrest from ventricular fibrillation and to prevent its recurrence. The addition of epinephrine hydrochloride is advocated only if cardiac standstill is present. The prognosis is directly related to the duration of relative anoxia sustained by the central nervous system and this depends on the speed and efficiency of diagnosis and treatment. The prevention of cerebral anoxia in the surgical patient with sudden cardiac arrest presents the surgeon and his operating team with a challenging problem. Improved methods of preventing, anticipating, diagnosing, and treating sudden cardiac arrest offer a practical opportunity for increasing the number of complete recoveries in surgical operations.

Removing Gasoline From Water Containers

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CURRENT recommendations[2] set up a rigid cleaning procedure for gasoline containers to be used for emergency or permanent transportation and storage of potable water. The Chief of Ordnance and the Surgeon General were dissatisfied particularly with the time limit on storage of water in gasoline containers after cleaning. It was requested that the Third Army Surgeon's Office conduct tests to determine whether this time limit could be extended. It also seemed advantageous to simplify cleaning procedures if possible. The main objectives in the cleaning of gasoline containers for use as potable water containers are *safety* and *acceptability* of the stored water.

Gasoline is a systemic poison either when ingested in quantity or when the vapors are inhaled. In addition, practically all gasoline, both regular and high-test, now contains tetraethyl lead which is also a systemic poison. Gasoline vapor in excess of 14,000 p.p.m. also forms an explosive mixture with air. These things must be considered at all times when handling "empty" gasoline containers. If the gasoline containers are well drained and flushed, it is improbable that there will be sufficient gasoline left in the container to act as a systemic poison in itself when mixed with drinking water. In any event the ingestion of a disabling or fatal amount of gasoline could not be accomplished unknowingly because of the strong taste of gasoline, even in small amounts.

Because the really dangerous material which might be found in the gasoline containers is lead, or tetraethyl lead, the cleaning of the containers becomes a problem of removing the lead, or the tetraethyl lead, to make the stored water safe, and to reduce the gasoline taste and odor to a point where the water will be satisfactory. Since tetraethyl lead is soluble in gasoline, and since such small quantities are used in the gasoline, lead would not ordinarily be expected to be present in properly cleaned containers in significant quantities. The United

[1] Headquarters Third Army.

[2] Letter from the Surgeon General, Department of the Army, to the Chief of Ordnance, Department of the Army, dated 15 Sept 1950.

States Public Health Service standards for the lead content of a drinking water supply to be used year in and year out give 0.1 p.p.m. as the upper limit. Gaertner[3] stated that symptoms of lead poisoning occur in man only after several months of a daily ingestion of 4 to 7 mg. and in from 3 to 4 weeks if the daily dose is 60 mg. Although it would be necessary to leave about 10 gallons of ethyl gasoline in a 10,000-gallon water container to obtain a 1 p.p.m. lead concentration in the water, it was believed possible that through long use of the containers for gasoline storage some of the tetraethyl lead might break down, leaving deposits of other lead compounds which might not easily be washed out of the containers. For this reason, test quantities of water were held in containers for a long period of time to determine whether the above hypothesis was correct and whether the deposited lead compounds, if any, would gradually be dissolved in the water.

After considering current reports, the water requirements of soldiers in the field, and the exigencies of the temporary necessity for a potable water supply from containers formerly used for gasoline, an attempt was made to set up an absolute maximum allowable lead content. Field Manual 21-10 gives the water requirement for soldiers as between 1 quart per day in cold climates and 3 gallons per day under extreme tropical conditions. If the lead content of a water supply were 1 p.p.m., it appears from Gaertner's figures that such a water supply could be consumed by soldiers under any conditions for a period of at least 2 months without danger of serious lead poisoning. Those drinking 1 quart per day would receive about 1 mg. of lead per day, and those drinking 3 gallons would receive about 10 mg. of lead per day. It is emphasized that this is not proposed as a general standard and that the 1 p.p.m. lead-content water was merely used as a hypothetical back-drop for the consideration of the results of this test. It was also useful in choosing a method of analysis and in devising a routine analytical procedure in the proper range.

Analytical Methods. The determination of lead as tetraethyl in amounts below 1 p.p.m. presented problems in selecting a suitable analytical method and in establishing a lead-free environment for performance of the routine tests. The method for determination of lead used was that of Snyder et al.[4] The test depends on the color change of dithizone and incorporates a room temperature digestion with iodine. Portions of alcohol diluted standardized gasoline containing 4, 8, and 12 micrograms of lead were examined by this method and the lead recovered was 4, 7.8 and 13.5 micrograms respectively. This method was considered sufficiently accurate and it was used in the ensuing routine lead tests. The threshold odor number was determined according to "Standard Methods for the Examination of Water and Sewage," Ninth edition, 1946.

3Quoted by Sollmann, T. H.: A Manual of Pharmacology. 7th edition. W. B. Saunders Co., Philadelphia, Pa., 1948.

4Snyder, L. J., et al.: Determination of lead in air; rapid micro-method for field use. J. Analytical Chemistry 20: No. 8, 1948.

Procedure. The sizes of containers used in the test were 750-gallon tanks, 375-gallon tanks, 250-gallon tanks, 55-gallon drums, and 5-gallon cans. About half of the samples from all of the cleaned containers were taken with the 1/4-gallon per minute knapsack filter. The remainder were taken as follows: (1) a 50-gallon per minute diatomite filter was used for sampling the 750-, 375-, and 250-gallon containers; (2) the 55-gallon drums were sampled by siphoning and filtering through standard laboratory filter paper; and (3) samples from the 5-gallon cans were taken by siphoning without filtering. No particular difference was observed in the quality of the samples which could be attributed to the method of sampling.

Test 1. A 750-gallon tank truck was used. The inside of this tank was rusty in spots but was considered to be fairly clean. There was a faint odor of fuel oil in the tank. It was rinsed with gasoline to insure contamination and then cleaned as follows: (1) It was steamed for 60 minutes using 2 pounds of a commercial dishwashing compound containing tetraphosphate, metasilicate, soda ash, and a wetting agent (dishine), and 30 minutes more using plain steam; (2) it was flushed thoroughly by hose with cold water to remove excess detergent and loosened sludge; (3) it was filled with clean water adding 0.3 gram of HTH (70 percent chlorine)(high-test hypochlorite) for each gallon of water, allowing a 30-minute chlorine contact time, then draining half the water out; and (4) 1½ pounds of powdered activated carbon were added and the tank was filled to overflowing with clean water. Samples were then taken at intervals for analysis.

Test 2. A tank truck which carried two 375-gallon tanks was used. One tank was damaged, reducing the total truck capacity to 375 gallons. The interior of this tank was very rusty and the bottom contained a lot of sludge. Although there was a definite odor of gasoline in the tank, it was rinsed with gasoline to assure contamination before cleaning. It was cleaned as follows: (1) It was steamed for 75 minutes without introducing any detergent; (2) flushed thoroughly by hose with cold water to remove the sludge; (3) filled and disinfected with 0.3 gram of HTH per gallon of water (this water was retained for the test); and (4) ¾ pound of activated carbon was added to the contents of the tank and mixed completely. After 30 minutes the first sample was taken for analysis.

Test 3. A 250-gallon tank trailer was used. This vehicle had been steamed and sandblasted. The interior had been painted with a nontoxic paint on 15 November 1950. Because this cleaning had been accomplished at the Atlanta General Depot, the tank was flushed thoroughly with cold water and then filled with water to test the effectiveness of the Depot tank recovery treatment.

Test 4. A 250-gallon tank trailer was used. This container had been steamed and sandblasted at the Atlanta General Depot on 15 November 1950. One baffled section had been painted, but the remainder of the

tank was spotted with rust at the time it was received for testing. Before cleaning, in this test, the container was rinsed thoroughly with gasoline to assure contamination. It was: (1) steamed for 60 minutes with 1 pound of dishine detergent followed by 15 minutes with clear steam; (2) flushed by hose with cold water to remove detergent; (3) filled with clear water and disinfected for 30 minutes with ¼ pound of HTH; and (4) drained completely and filled to overflowing with clear water adding ½ pound of activated carbon, which was allowed to set for 30 minutes before taking the first samples.

Test 5. A 55-gallon drum, which had been in constant use as a container for kerosene up to the time of the experiment was tested. It was rinsed thoroughly with gasoline, to assure contamination, and then was: (1) steamed for 45 minutes using ½ pound of dishine mixed with steam followed by 15 minutes with plain steam; (2) rinsed thoroughly and filled with clean water; (3) disinfected using ¼ pound of HTH allowing 30 minutes chlorine contact time; (4) drained and filled with clear water adding ½ pound of activated carbon to the water and mixing by rolling and shaking the container for 15 minutes and then draining; and (5) filled and drained twice with clean water to remove all excess carbon. It was filled a third time with clean water which was to be sampled.

Test 6. A 55-gallon drum which had been in constant use as a container for an unknown solvent prior to the test was used. It was rinsed with gasoline to assure gasoline contamination and steamed for 45 minutes only, with ½ pound of dishine added in the steam. The remaining steps were the same as in test 5.

Test 7. Two 5-gallon cans were cleaned for this test. Both cans were rusty and dirty inside. Although they had been used daily at the General Depot as gasoline containers, they were rinsed with gasoline before cleaning. Can A was washed with dishine detergent and hot water at about 140° F. and can B was washed with dishine detergent and cold water. Both cans were (1) drained and then shaken for 5 minutes using 2 ounces of dishine detergent in 2 gallons of water; (2) drained and rinsed twice with clean water, the second rinse being accomplished by filling the can to overflowing and then draining; (3) filled, adding 1 ounce of HTH, and allowed to stand 30 minutes for chlorine contact; (4) drained and filled with clean water adding ¼ pound of activated carbon, shaking for 15 minutes, then draining; (5) rinsed three times to remove the excess carbon; and (6) filled to overflowing with clean water for sampling at intervals.

Test 8. Two 5-gallon cans which had been in use daily as gasoline containers but were rinsed with gasoline prior to the test were used. Both cans were washed with vapor cleaning compound (Ordnance Supply Item 51-C-1568-320). Hot water at about 140° F. was used for can A and cold water for can B. The cleaning procedure outlined in test 7 was followed with the appropriate substitution of detergent.

Test 9. Two 5-gallon cans were cleaned as in Test 7 using hot water for can A and cold water for can B. The detergent used in cleaning the cans in this test was haemo-sol (a commercial special purpose detergent of unknown composition).

Test 10. Two 5-gallon cans were used. They were, as were all other 5-gallon cans, used, dirty and rusty on the interior. Can B had been cleaned previously in the Third Army Medical Laboratory with trisodium phosphate and a hot 1 percent nitric acid solution. It was rinsed with gasoline to assure contamination. The reuse of this can was made necessary by a 5-gallon can shortage. The detergent used in cleaning these cans was mobile laundry detergent (Quartermaster Supply Item 51-D-175). Again hot water at about 140° F. was used in can A and cold water was used in can B. They were (1) rinsed three times with 2 gallons of clean water for the first two rinses and filled to overflowing and drained for the third rinse; (2) washed by shaking for 5 minutes with 2 ounces of mobile laundry detergent in 2 gallons of water, then drained; (3) rinsed, once with 2 gallons of clean water and twice by filling to overflowing, draining the can after each rinse; (4) filled with water adding 1 ounce of HTH and allowing 30 minutes for chlorine contact then draining; and (5) filled to overflowing with water for test samples.

Test 11. A 5-gallon can was used as a control. The residual gasoline was drained, and the can was filled to overflowing with clean water. The can was then drained and refilled with water for sampling at intervals.

RESULTS

In examining the results (fig. 1) it must be borne in mind that this test was especially severe. The containers were rough and rusty and the same water remained in the containers for a much longer period than would normally be the case. The Atlanta water used was extremely soft and could, therefore, be expected to show more than average aggressiveness toward the solution of any lead deposits and to promote further rusting of the containers. It was also considered that the rusty containers presented the ultimate problem in gasoline removal. In spite of these handicaps most of the tests produced satisfactory water containers from the standpoint of both lead content and gasoline odor, at least for quick turnover or short-time storage. The maximum amount of lead accumulated in the water from any of the containers was 0.2 p.p.m. which was well within safety limits for temporary water supplies. It is only one-fifth the amount allowed as a hypothetical maximum. In all fairness it must be stated that the two commercial detergents used (dishine and haemo-sol) were not designed to remove gasoline.

Mobile laundry detergent was the best detergent tried for the removal of gasoline. In test 10 it removed the gasoline satisfactorily with hot or with cold water. The high threshold odor number noted on the fourteenth day in can A, test 10, is misleading. It must be remembered that

Days Elapsed	TEST NO.1 Tank Truck 4304756 750 gal.		TEST NO.2 Tank Truck 489466 375 gal.		TEST NO.3 Tank Trailer 045672 250 gal.		TEST NO.4 Tank Trailer 0835664 250 gal.		TEST NO.5 Drum 55 gal.		TEST NO.6 Drum 55 gal.		TEST NO.7 Can 7-A 5 gal.		Can 7-B 5 gal.		TEST NO.8 Can 8-A 5 gal.		Can 8-B 5 gal.		TEST NO.9 Can 9-A 5 gal.		Can 9-B 5 gal.		TEST NO.10 Can 10-A 5 gal.		Can 10-B 5 gal.		TEST NO.11 Control Can 5 gal.		Filling Water	
	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON	Pb	TON
0	0	0			0	0			0	0	0	0	0	1.5	0	8	0	0	.03	15	0	2	0	0	0	0	0	0	0	7	0	0
1	0	0			0	0			0	0	.02	0	0	2	.03	6	0	0	.12	20	0	6	.02	0										
2	0	0			0	0			0	0	0	0																						
3																													0	0	0	12		
5			0	1			0	0					0	2	.03	4	0	0	.17	8	.03	3	0	2										
6	0	0	0	0	0	0	0	0	0	0	0	0																						
7			0	0			0	0																			0	7	0	0				
8													0	0	.03	15	0	0	.18	18	.03	6	0	0							0	18		
9	0	0			0	0			0	0	0	0																						
11			0.	0			.07	3																			0	13	0	2				
13													0	5	.03	8	0	0	.14	15	.03	15	0	2										
14	0	0	0	0	0	0	0	1	0	0	0	0															0	50	0	0				
16																															0	0		
19			0	0			.07	4																										
21													0	0	0	0	0	0	.2	2	0	10	0	0										
22	.01	0			0	0			0	0	.02	0																						
27							.08	2																										
36													.1	4	0	4	0	3	.14	9	0	12	0	5							0	3		
37					0	0			0	0	0	0																						
38																															0	17		
42							.1	6																										
43													0	3	.03	15	0	1	.09	9	0	8	0	1										
44					0	0			0	0	0	3																						
45																															0	12		
49							.11	2																							0	17		
50																																		
51																											0	10	.01	0				

Pb = Lead content in p.p.m.
Ton = Threshold odor number

Figure 1. *Summary of results of gasoline removal tests.*

no activated carbon was used in either can in this test, whereas, all of the other 5-gallon cans were treated with activated carbon in addition to the various detergents used. The odor remaining in can A was amenable to carbon treatment. For all practical purposes, both taste and odor were completely removed from the water in this can by 30 minutes' contact with 0.1 ounce of activated carbon added on the fifty-first day of the test. The excellent results produced with cold water in can B in this test may be questioned because the can used had been quite thoroughly cleaned prior to intentional contamination with gasoline for this test. The interior of the can was so rough and rusty however, that it was difficult to clean. The results should not be discounted materially because the active gasoline-containing service of the can had been interrupted by cleaning prior to this test. The mobile laundry detergent removed gasoline remarkably well when used with cold water.

The reason no lead was recovered from the water stored in the 5-gallon control can is not clear. This can had been used previously as a gasoline container for at least 1 year and should have been as contaminated with lead as any of the other test containers. It is possible that the washing processes applied to some of the other containers tended to make the slight lead deposit sufficiently soluble to show up in the stored water without entirely removing the lead deposit; whereas, a slight lead deposit in the control can remained intact and insoluble during the cold water rinse and subsequent storage.

CONCLUSIONS

The health hazard in using cleaned gasoline containers for water transportation is negligible. The cleaning procedures used in tests 1, 2, 3, 5, and 6, which closely follow the procedure recommended by the Surgeon General, resulted in containers in which water can be safely stored for at least 44 days, and which could be safely used for an indefinite period in the fill and draw transportation of water. Steam was the best cleaning agent used for the removal of gasoline. Mobile laundry detergent when used with either hot or cold water is an excellent substitute for steam in gasoline removal.

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Adie's Syndrome

Norman Yourish, *Captain, MC, U.S.A.* [1]

THE so-called "tonic pupil" is a pupil which reacts very slowly to light and convergence. Adie's syndrome consists of the tonic pupillary reflex, plus absence of knee and ankle jerks in an otherwise healthy person. This combination of findings is likely to elicit a barrage of neurologic and serologic tests to rule out neurosyphilis, brain tumor, subdural hematoma, and oculomotor palsy.

CASE REPORT

A 21-year-old white man, was admitted to this hospital complaining of headache, malaise, chills, and fever. These symptoms had come on within 24 hours after receiving smallpox, tetanus, and typhoid immunizations. On admission the patient's temperature was 102° F. He was lethargic, but was able to answer questions intelligently. Physical examination was negative, except for a dilated, fixed right pupil, and markedly diminished knee jerks and ankle jerks.

Laboratory findings were normal. Within 8 hours the temperature had subsided. The patient felt well and his lethargy disappeared. His abnormal pupillary findings persisted, and an ophthalmologic consultation was requested.

The vision, visual fields, and eye grounds were normal. The right (tonic) pupil was 4 mm. in diameter, fixed to light on both direct and consensual stimulation, and fixed to convergence. It was slightly elliptical in shape. The left (normal) pupil was 3 mm. in diameter and reacted normally to all stimuli. On prolonged stay in a dark room, no appreciable dilation was seen in the right pupil. On prolonged convergence (reading) the right pupil became smaller than the left and remained so even on distant fixation. After reading, the right pupil measured 2.5 mm. and the left 3 mm. On instilling paredrine both pupils dilated widely. On instilling weak (2.5 percent) methacholine chloride the right pupil contracted maximally within 5 minutes and the left pupil remained unaffected. On using 0.5 percent eserine both pupils contracted maximally. No reaction to light or convergence could be ascertained after eserine instillation.

The final diagnosis at discharge was immunization reaction, and Adie's syndrome.

[1] U.S. Army Hospital, Fort Dix, N. J.

DISCUSSION

The tonic pupil is unilateral in 80 percent of cases and the vast majority are in young women. The pupil reacts very sluggishly to the usual stimuli. On prolonged stay in the dark it will usually dilate partially, and remain so for some time after emerging from the darkness. On prolonged convergence, as in reading, it will become nearly as miotic as the normal pupil and when reading is stopped it will continue to be miotic for a long time. For these reasons it is not a truly fixed pupil but a very slowly reacting one. It is usually seen as a slightly dilated pupil compared to the normal pupil but this is not always the case, as it may even be smaller. This point has not always been emphasized in the past.

The Adie's pupil reacts promptly and fully to all mydriatics, which is not true of the Argyll Robertson pupil. It also reacts promptly to miotics. Lowenstein and Friedman [2] found that after using eserine, normal light and convergence reactions could be obtained in the tonic pupil. We tried this carefully on two occasions and could get no reaction beyond miosis. This is in agreement with Walsh [3] who was unable to confirm the observations of Lowenstein and Friedman. In our patient, 12 hours after eserine instillation the tonic pupil was still miotic and gave no response to light or convergence.

The use of 2.5 percent methacholine chloride was recommended by Scheie[4] and Adler[5] as a test for tonic pupillary reaction. The tonic pupil is very sensitive to this weak solution and contracts promptly, whereas the normal pupil is not at all affected. In our patient the tonic pupil showed maximal response in 5 minutes. This is in agreement with Walsh who stated that this test should be performed routinely whenever Adie's syndrome is suspected.

Confusion with tabes dorsalis is common because of the fixed pupil plus the absent knee jerks and ankle jerks. The differential diagnosis is relatively easy. The Argyll Robertson pupil associated with tabes dorsalis is miotic, reacts promptly to convergence but not to light, and dilates poorly with mydriatics. The tonic pupil is usually partly dilated, reacts to neither light nor convergence (except very slowly), and reacts normally to mydriatics.

The cause of this condition is obscure. Most authors consider it a disease of the sympathetic nervous system. Kennedy[6] and associates

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[2] Lowenstein, O., and Friedman, E. D.: Adie's syndrome (pupillotonic pseudotabes). Arch. Ophth. 28: 1042-1068, Dec. 1942.

[3] Walsh, F. B.: Clinical Neuro-Ophthalmology. The Williams & Wilkins Co., Baltimore, Md., 1947. pp. 197-200.

[4] Scheie, H. G.: Site of disturbance in Adie's syndrome. Arch. Ophth. 24: 225-237, Aug. 1940.

[5] Adler, F. H.: Physiology of the Eye. C. V. Mosby Co., St. Louis, Mo., 1950. p. 172.

[6] Quoted by Duke-Elder, S.: Textbook of Ophthalmology, Volume IV. C. V. Mosby Co., St. Louis, Mo., 1949. pp. 3799-3801.

believed that emotional disturbances played a role and that a hypothalamic disturbance is the cause. Lowenstein and Friedman believed that it was a heredodegenerative disturbance of the vegetative centers of the brain stem. Scheie and Adler believed a lesion of the postganglionic neurons leaving the ciliary body to be the cause. This localization is an ingenious one as it would explain the reaction of the iris to dilute methacholine chloride, as being on the basis of postganglionic denervation of the iris musculature, followed by sensitization to drugs stimulating the parasympathetic nerves. This, however, would not explain the tendon areflexia. Leatheart[6] also believed a lesion of the ciliary ganglion to be the cause and suggested as a name for the syndrome "ciliary ganglion iridoplegia."

No treatment is needed beyond explaining to the patient that the condition exists, and that it is benign. Sykowski[7] mentioned the use of pilocarpine in two patients to relieve the lowered tolerance to sunlight, caused by the semidilated pupil.

[7]Sykowski, P.: Tonic pupils. Am. J. Ophth. 34: 286-287, Feb. 1951.

A Sectional Leg Splint

Burdick G. Clarke, *Lieutenant Commander, M. C., U. S. N. R. (1)*

THE high frequency of extensive soft tissue wounds and of compound fractures of the legs is well recognized in modern warfare. To minimize shock and soft tissue damage it is necessary to splint these limbs early. The hinged, half-ring leg splint, known variously as the Keller-Blake splint or the half-ring Thomas leg splint, is a standard appliance for this purpose in the Armed Forces. Because

Figure 1. Folding sectional half-ring leg splint compared with a standard Thomas splint.

this indispensable item is 4 feet long, it is difficult to transport in ground warfare, and too large for convenient stowage aboard ships or raft. To overcome these disadvantages, a folding, sectional modifi- on of the standard splint (fig. 1) has been designed. It is proposed this item be listed as expendable, to be discarded when the pa-

With the 1st Evacuation Hospital, Fleet Marine Force, at time of writing this le; now at New Haven Hospital, New Haven, Conn.

Figure 2. Container. Figure 3. Traction strap, large-sized battle dressings, 2 medium-sized battle dressings, triangular bandage, tourniquet, 4 muslin bandages, safety pins, and morphine syrette.

Figure 4. Assembled sectional leg splint.

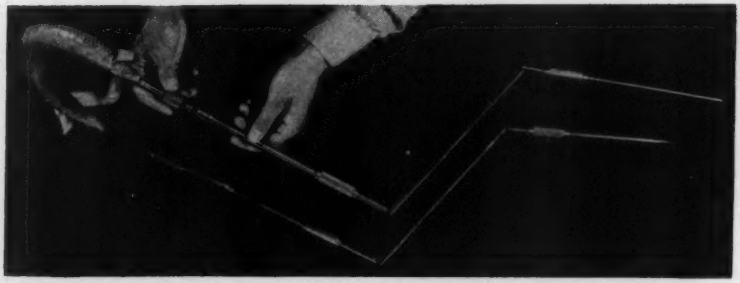

Figure 5. Assembly of sectional leg splint.

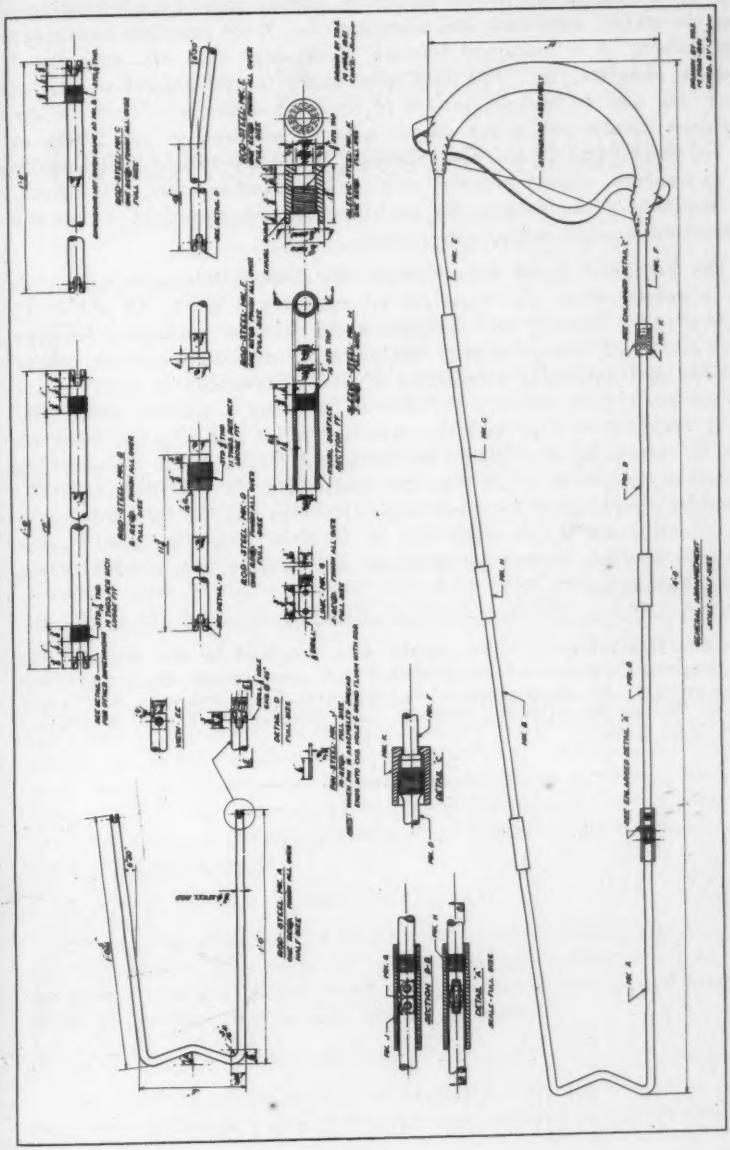

Figure 6.

tient's movement to the rear permits definitive treatment. It may be packed in a small waterproof, camouflaged, disposable container (fig. 2) holding, in addition to the splint, enough camouflaged dressings, traction straps, bandages, and morphine (fig. 3) for complete emergency management of a compound fracture of the leg. This kit, weighing 7 pounds complete, is fitted with wire hooks for attachment to belt or pack and may be brought forward to dressing stations in land or amphibious combat while the carrier's hands are free to use litters or to aid in self-protection. The container is readily stowed, individually or in numbers, aboard vessels, small boats, landing craft, helicopters, or airplanes. It is adapted for such specialized operations as air-sea rescue and medical resupply by airdrop.

The sectional splint alone weighs 4½ pounds; 8 ounces more than the standard splint. The complete kit measures 2 3/4 by 12 1/4 by 13 inches (0.25 cu. ft.); the standard model without packaging requires 0.45 cu. ft. of storage space. The parts are manufactured with coarse threads and sufficient tolerances to permit assembly in less than 1 minute even when soiled with sand or dirt. The assembled piece (fig. 4) is identical in size with the standard splint and is made ready for use by extending the hinged sections and locking them by screwing threaded sleeves in place over the joints (fig. 5). (EDITOR'S NOTE: Enlarged diagrams of the exact specifications (fig. 6) for guidance in the construction of the splint may be obtained from the Armed Forces Medical Journal, Bureau of Medicine and Surgery, Department of the Navy, Washington 25, D. C.).

ACKNOWLEDGEMENT: The models were produced in the shops of the 7th Engineer Battalion, Fleet Marine Force. Development of designs was made possible by the assistance of Lieutenant G. D. Schryver, USMC, and of Mr. William R. Ahrendt. Drawings were prepared by Technical Sergeant T. D. Scott, USMCR.

Early Recognition of Peripheral Nerve Injuries[1]

Anielio F. Mastellone, *Lieutenant Colonel, MC, U. S. A.*
Raoul C. Psaki, *Lieutenant Colonel, MC, U. S. A.*
John H. Kuitert, *Lieutenant Colonel, MC, U. S. A.*

THE incidence of injuries to peripheral nerves increases in direct proportion to the casualty rate in modern warfare. Early diagnosis with employment of relatively simple physical methods of treatment designed to prevent contracture and stiffness of joints directly effects the ultimate return of function and usefulness of the involved limb. This is especially true with respect to the hand. Although clinical diagnosis of a peripheral nerve injury is comparatively simple, mistakes are made and correct diagnosis is often greatly delayed simply because the possibility of the existence of a nerve injury is not considered. In most casualties, wounds immediately more serious and requiring more heroic emergency measures exist and, no doubt, contribute to the frequent oversight of the possibility of nerve involvement.

It has been the common experience of nerve centers that in those nerve injuries in which the diagnosis and treatment were delayed the final degree of recovery of function was gravely prejudiced. The examination of casualties should, therefore, include a few relatively simple tests designed to detect the existence of peripheral nerve injuries even though a limb may be encased in plaster because of bone, muscle, or vascular injury. The existence of a nerve injury should be recorded in the forward areas .

SENSORY TESTS

The integrity of the nerves of the extremities commonly affected may be demonstrated by testing for sensory loss or dysfunction in certain peripherally located areas which are generally easily accessible despite the presence of dressings, splints, or plaster.

MOTOR TESTS

The voluntary muscle test is an extremely accurate method of quick diagnosis. Although a few of the muscles supplied by each nerve can

(1) From Walter Reed Army Hospital, Washington, D. C.

be tested very rapidly, this method of examination depends on the experience of the examiner for its accuracy. The functional method is simple and can be used by anyone with ease, rapidity, and accuracy.

Upper extremity

Radial nerve injury causes wrist drop manifested by inability to extend (1) the wrist, (2) the fingers at the metacarpophalangeal joints with the interphalangeal joints flexed, and (3) the thumb.

Median nerve injury causes ape hand manifested by inability to (1) make a five-finger cone, (2) rotate the thumb over the palm, (3) abduct the thumb at a right angle to the palm, and (4) flex the index finger when the others are extended.

Ulnar nerve injury causes claw hand manifested by inability to make a four-finger cone, and to abduct and adduct the fingers.

Lower extremity

Femoral nerve injury causes inability to extend the knee. Sciatic nerve injury causes flail ankle manifested by inability to extend or flex the ankle. Common peroneal nerve injury causes foot drop manifested by inability to dorsiflex the ankle, and to extend the toes. Posterior tibial nerve injury causes inability to plantar flex the foot, and to flex the toes.

Table 1 gives a more detailed outline of the sensory and motor function of selected peripheral nerves most commonly injured in war wounds.

No attempt has been made to discuss the various diagnostic and prognostic aids which are available at nerve centers. Electrical examination of muscles including electromyography is of great importance not only in establishing the more exact localization and the type of peripheral nerve injury, but also as a prognostic guide.

TREATMENT

The prompt recognition of incidental nerve lesions is essential to total recovery and their presence should be recorded when recognized. The absence of nerve lesions at the point of injury is equally important and should likewise be noted. Early treatment of peripheral nerve lesions should not be allowed to interfere with saving life or limb but is required to prevent serious sequelas, often irreversible, such as contractures, stiffness and fibrosis of joints and muscles. Until such time as the patient arrives at a point in the chain of evacuation where definitive treatment can be administered, it is important to support the involved part. For the upper extremity a simple sling may give sufficient support to prevent stretching of the paralyzed parts. A simple foot-drop splint may be all that is necessary in the lower extremity to preserve functional position. Contractures of muscles and tendons and stiffness of joints may be prevented by frequent passive movement of the involved parts through a full range of motion. If possible, the patient should be instructed to do this for himself.

TABLE 1. *Objective findings in peripheral nerve injuries*

Lesion	Motor system		Sensory system
Nerve	*Muscle*	*Function involved*	*Sensory involvement*
Axillary	Deltoid	Abduction of arm to horizontal plane	Over deltoid muscle
Musculocutaneous	Biceps brachii	Flexion and supination of forearm	Anterolateral surface of forearm
Radial	Triceps Extensor carpi radialis longus and brevis Extensor digitorum communis Extensor pollicis longus and brevis	Extension of elbow Extensor of wrist, prox. phalanges and thumb (Wrist and finger drop)	Web between 1st and 2nd metacarpal on dorsum of hand or no sensory loss
Ulnar	Flexor digitorum profundus IV and V Flexor carpi ulnaris Flexor pollicis brevis (½) Abductor digiti quinti Opponens digiti quinti Lumbricales III and IV Interossei Adductor pollicis	Flexion of distal interphalangeal joint of ring and little fingers Flexion of wrist with ulnar deviation Flexion of metaphalangeal joint of thumb Abduction of little finger Opposition of little finger Flexion of metaphalangeal joints of ring and little fingers Abduction and adduction of fingers Adduction of thumb	One-half of ring and all of little fingers and hypothenar eminence and corresponding area of dorsum on hand

TABLE 1. *Objective findings in peripheral nerve injuries*—Continued

Lesion	Motor system		Sensory system
Nerve	*Muscle*	*Function involved*	*Sensory involvement*
Median	Flexor digitorum profundus I and II	Flexion of distal metaphalangeal joint of index and middle fingers	Lateral 3½ fingers and corresponding portion of palm
	Pronator teres	Pronation of forearm	
	Flexor carpi radialis	Flexion of wrist - radial deviation	Distal 2 phalanges of index and middle fingers and lateral half of ring fingers on dorsal surface
	Flexor digitorum sublimis	Flexion of proximal interphalangeal joint	
	Flexor pollicis longus	Flexion interphalangeal joint of thumb	
	Flexor pollicis brevis (½)	Flexion of metaphalangeal joint of thumb	
	Abductor pollicis brevis	Abduction of thumb in plane vertical to palm of hand	
	Opponens pollicis	Opposition of thumb to other fingers	
	Lumbricales I and II	Flexion of metaphalangeal joints of index and middle fingers	
Femoral	Iliacus	Flexes thigh; tilts pelvis forward	Anteromedial aspect of thigh, foot, leg, and knee
	Pectineus	Flexion of thigh on abdomen	
	Sartorius	Flexes leg on thigh and thigh on pelvis; rotates thigh laterally	
	Quadriceps	Extension of knee	

TABLE 1. *Objective findings in peripheral nerve injuries*—Continued

Lesion	Motor system		Sensory system
Nerve	*Muscle*	*Function involved*	*Sensory involvement*
Obturator	Obturator externus abdominis	Outward rotation of thigh	
	Gracilis	Flexes and medially rotates leg; adducts thigh	
	Adductor longus	Adduction of thigh	
	Adductor magnus	Adduction of thigh	
	Adductor brevis	Adduction of thigh	
Sciatic			
A. *Nerve to hamstrings*	Hamstrings Biceps femoris Semitendinosus Semimembranosus	Flexion of knee	
B. *Common peroneal*			
Superficial peroneal	Peroneus longus	Eversion of foot	Dorsum of foot and lateral aspect of leg
	Peroneus brevis		
Deep peroneal	Tibialis anterior		
	Extensor digitorum longus	Dorsiflexion of foot and toes	Web between great and 2d toes on dorsum of foot
	Extensor hallucis longus		
	Peroneus tertius		
	Extensor digitorum brevis		
C. *Tibial*	Gastrocnemius	Plantar flexion of ankle	Sole of foot
	Soleus		
	Tibialis posterior	Inversion with plantar flexion of foot	
	Flexor digitorum longus pedis	Flexion of toes	
	Flexor hallucis longus	Flexion of great toe	

SUMMARY

Early recognition of peripheral nerve injuries and early support of the paralyzed parts and the prevention of joint stiffness and muscle and tendon contractures are important.

Metallic Foreign Body in the Appendix

A Case Report

James F. Dougherty, *Lieutenant, junior grade, MC, U. S. N. R.*

Samuel L. Cohen, *Captain, MC, A. U. S.*

Peter Zanca, *Colonel, MC, U. S. A. (1)*

A SOLDIER, 22-years-old, reported to the hospital on 16 January 1951. On the preceding day he first noticed generalized abdominal pain and nausea. There was no vomiting, constipation, or diarrhea. The pain became acute and localized in the right lower abdominal quadrant. A careful history revealed that the patient had eaten a squirrel killed with buckshot 2 or 3 years earlier.

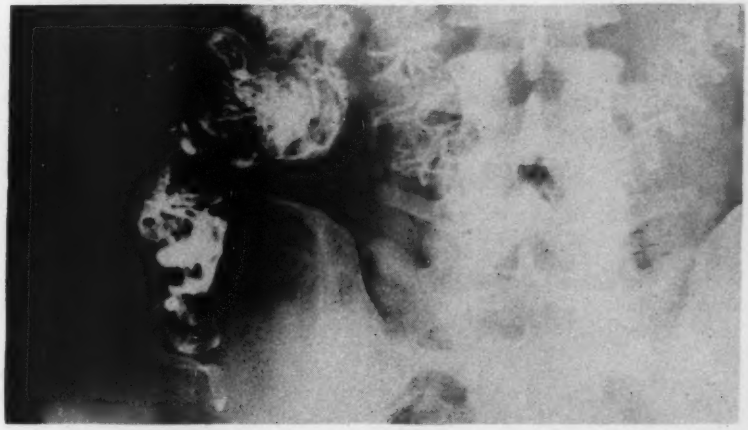

Figure 1. Barium enema examination showing a radiopaque foreign body in the appendix.

On physical examination the abdomen was soft. There was moderate tenderness over McBurney's point. There was no rigidity or rebound tenderness. Rectal examination was negative. The leukocyte count

(1) U. S. Army Hospital, Camp Cooke, Calif.

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was 11,000 with 61 percent neutrophils, 33 percent lymphocytes, and 1 percent monocytes. Although history and physical examination suggested that the patient was suffering from an acute appendicitis, however, the findings were not conclusive and a conservative plan of therapy was indicated. A plain film of the abdomen was taken which revealed a metallic foreign body about 3 mm. in diameter in the right lower abdominal region. Barium enema examination showed this foreign body in the lumen of the middle third of the appendix (fig. 1). The abdominal symptoms persisted so on 5 February an appendectomy was performed. A lead buckshot (fig. 2) was recovered. There was moderate localized mucosal injection about the foreign body and microscopic examination of the appendix revealed a lymphoid hyperplasia.

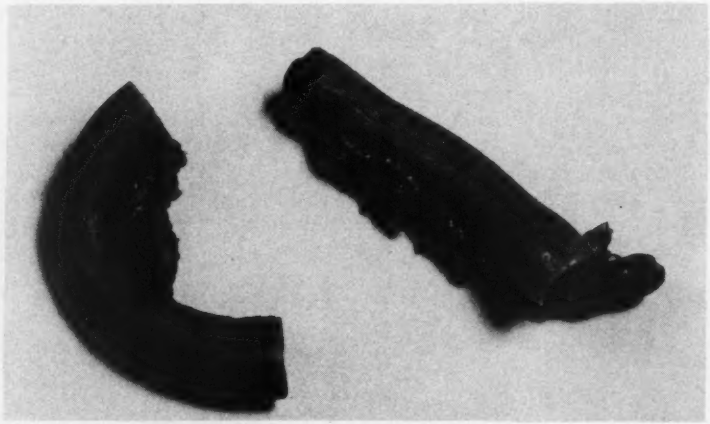

Figure 2. Pathologic specimen showing buckshot in lumen of appendix.

CONCLUSIONS

Foreign bodies in the appendix may cause symptoms simulating acute or chronic recurrent appendicitis. This condition should be considered in the differential diagnosis of pain in the right lower abdominal quadrant.

Dental Responsibility in Oral Cancer

Eugene J. Murphy, *Lieutenant Commander, DC, U. S. N. R. (1)*

THE important position held by the dentist with regard to the early detection of oral cancer has been recognized by the dental and medical professions for only a short time. Because the dentist is a specialist in treating the mouth it is imperative that he accept this responsibility. In the past dentistry has received very little encouragement in this field. It is only recently that a cancer institute has made teaching grants to dental schools.

The early symptoms of oral cancer are rarely painful or alarming to the victims. Martin *(2)* pointed out that these persons frequently enjoy excellent health. The common practice of having a dental checkup twice a year enables the family dentist to examine the mouth under almost ideal conditions. Failure to notice and recognize oral cancer symptoms through carelessness on the part of the dentist has cost many lives. It is the dentist's duty to examine the entire oral cavity, not just the teeth and gums. Any deviation from normal oral anatomy must be thoroughly investigated and a definite diagnosis established as soon as possible. Procrastination on the part of the dentist or physician may often prove fatal. Robinson *(3)* emphasized the fact that the man who first detects a lesion or growth should complete the diagnosis and if a biopsy is indicated, it should be made by him and reported by a qualified oral pathologist.

Blair et al. *(4)* believed that, with the possible exception of involvement of the paranasal sinuses, oral cancer should be readily detected by the careful observer. They maintained that the clinical appearance and findings on palpation of these early growths are usually

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(1) Veterans Administration Hospital, Louisville, Ky.

(2) Martin, H.: Mouth Cancer and the Dentist. Monograph. Apr. 1949.

(3) Robinson, H. B. G.: Looking a Gift Horse in the Mouth. J. Michigan State Dent. Soc. 32: 116, June 1950.

(4) Blair, V. P., Moore, S.; and Byars, L. T.: Cancer of the Face and Mouth. C. V. Mosby Co., St. Louis, Mo., 1941.

so characteristic that their nature and relative virulence can be gaged with accuracy. Most practicing dentists and physicians, however, do not possess this ability. In every case it is wise to base a diagnosis on a biopsy report. In 21 years of both general and specialized practice I have seen many oral neoplasms but have never completed a diagnosis without a report from the pathologist.

The use of intraoral roentgenograms often helps to differentiate between salivary duct or gland obstructions and cervical lymph node involvement. This is particularly true when there is a lump or so called "knot" in the neck. Nathanson *(5)* noted that frequently the first symptom of a highly malignant cancer of the tonsil which is noticed by the victim is a lump in the neck. Ackerman and del Regato *(6)* classified oral cancers as follows: (1) carcinoma of the lower lip; (2) carcinoma of the upper lip; (3) carcinoma of the mobile portion of the tongue (anterior two-thirds); (4) carcinoma of the floor of the mouth; (5) carcinoma of the buccal mucosa; (6) carcinoma of the upper gingiva; (7) carcinoma of the lower gingiva; and (8) tumors of the lower jaw. To this we would add tumors of the hard and soft palate, tonsil, and oral pharynx.

The following cases were encountered in this hospital and were selected from many cases seen over a 4-year period. The dental examiner in a large general hospital sees a greater number of patients than the average dentist, but detection of mouth cancer depends on how well the examination is done and not on the number of patients seen.

CASE REPORTS

Case. 1. A 54-year-old man reported to the dental clinic for routine dental roentgenograms and examination. He was wearing full upper and lower acrylic dentures which had been made about 8 months earlier. Examination disclosed a red ulceration about the size and shape of the little fingernail just posterior to the junction of the hard and soft palate and slightly to the right of the median line. The post-dam area of the upper denture did not extend to within from 6 to 8 mm. of the lesion and clearly was not a constant source of irritation. The patient was not aware of any particular soreness but stated that he had recently noticed a slight difficulty when swallowing. He recalled that at the time the dentures were made the dentist mentioned that he had a spot in the palate which was probably caused from overextension of the old vulcanite denture he had worn for about 16 years. A biopsy specimen was submitted to the pathologist who reported squamous cell carcinoma. The cancer had infiltrated into the tonsil and pillar, making the prognosis extremely bad. This is an example of a dentist ignoring a lesion on the assumption that it was merely caused by a denture irritation.

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(5) Nathanson, I. T.: Medical progress; Cancer; results of treatment. New England J. Med. 229: 468-480, Sept. 1943.

(6) Ackerman, L. V., and del Regato, J. A.: Cancer: Diagnosis, Treatment, and Prognosis. C. V. Mosby Co., St. Louis, Mo., 1947.

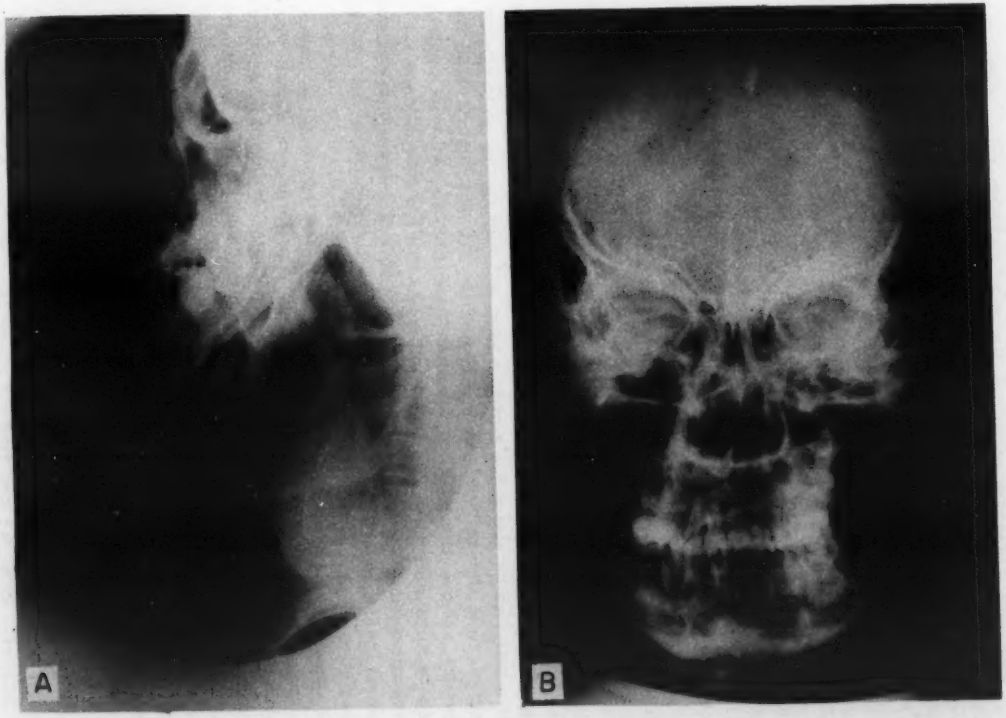

Figure 1. (case 2). Carcinomatous invasion of the mandible. (A) *Lateral view.* (B) *Anteroposterior view.*

Case 2. A 52-year-old man was seen in the dental clinic after full-mouth roentgenograms had been routinely taken the day before. He remarked that he hoped there were no teeth to be extracted as he suffered from diabetes and always had pain and swelling after his teeth were removed. On examination an irregularly-shaped ulcer was seen arising from a partially healed lower molar socket on the left. According to the patient the tooth had been extracted about 5 or 6 months before with the usual postoperative pain and swelling. He returned to the dentist several times over a period of from 5 to 6 weeks for treatment and assumed that everything was all right because the pain and swelling had subsided. A diagnosis of squamous cell carcinoma was made from our biopsy specimen.

Roentgenograms (fig. 1) showed extensive involvement of the mandible. The cervical lymph nodes were not enlarged. The ulcer was small and did not appear to have reached the floor of the mouth. A radical neck dissection and removal of the left portion of the mandible beyond the symphysis was necessary. This case demonstrates that slowly healing sockets or wounds of the mouth must be viewed with suspicion and not ascribed to an infection or systemic disease.

Case 3. A 48-year-old man was referred to me by a country practitioner because of a dull, nagging ache in all the upper teeth on the left side which had persisted for almost a year and was getting more severe every day. In the service and in civilian life he had been treated for sinusitis several times. The physician had referred him to a dentist when he complained that his teeth bothered him. The dentist took full-mouth roentgenograms but failed to find any foci or infection or even a carious lesion and he bluntly suggested that the patient should seek psychiatric treatment. Examination in this hospital disclosed an almost complete complement of teeth with only the upper third molars missing. They had been extracted many years earlier. There was moderate abrasion caused by excessive tobacco chewing but no signs of infection or caries. The tissues were normal and healthy in appearance. Because we were satistied that the pain was not of dental origin and the roentgenograms showed a cloudiness of the antrum, the patient was referred immediately to the ear, nose, and throat service where after interpretations of the roentgenograms by the radiologist carcinoma of the antrum was suspected. This was confirmed by biopsy. This type of hidden neoplasm is not a true oral cancer unless it fungates into the palate. This case demonstrates indirect cancer detection through the proper cooperation and consultation with other services in the hospital. When we can find no cause for a patient's complaint we must never assume that we are infallible and that the patient is a hypochondriac or a neurotic.

Case 4. A 62-year-old man visited the clinic shortly after being hospitalized because he was having trouble with a sore on the inside of his cheek. His dentures were 2 years old. He believed that the

posterior teeth were set out too far and this caused him to bite his cheek. Because this had bothered him for at least a year he had visited 4 or 5 dentists for adjustment. The last visit had taken place 3 months before his admission to the hospital. Examination showed a granular, wartlike growth about the size of a copper coin in the center of the buccal pad. The patient was obese and any swelling present was not discernable. There were small, scattered leukoplakial patches on the mucosa surrounding the growth but they did not extend downward into the lower ridge or the velum. None of the dentists consulted previously had mentioned an abnormal condition in his mouth or did more than trim the dentures. The biopsy specimen was diagnosed carcinoma. It was a slow growing lesion. This type of malignancy while not deep-seated often invades the body of the maxilla with fatal consequences.

Case 5. A 53-year-old man was examined physically and roentgenographically in the dental clinic for a possible focus of infection. He was wearing upper and lower partial dentures of cast gold which were well designed and beautifully finished and the entire mouth gave evidence of exceptional care on the part of both the patient and his dentist. During the examination, when the patient was requested to raise the tongue to it's fullest extent, a lesion was seen on the ventral surface. It extended from between the lingual vein and the plica fimbriata to the border but was not visible on the dorsum of the tongue. It measured about 7 by 3.5 mm. and had a smooth, glossy, lumpy appearance. Although the patient had noticed a little "bump" under the tongue for several months, he thought the lower denture was causing the trouble. He had visited his dentist who checked the partial denture, examined the area of irritation and advised him to leave the denture out as much as possible until the trouble disappeared. Because no particular discomfort or pain was present the patient assumed it was just another "canker sore." The biopsy report was squamous cell carcinoma of the tongue. This is an illustration of cancer appearing in a well cared for mouth. It is also an example of a dentist's failure to recognize a cancerous lesion.

Case 6. A 42-year-old man was referred to me by a physician who reported that the patient had a cellulitis of the floor of the mouth. The man was acutely ill and complained of pain in the left mandible. One week prior to admission he noticed some difficulty in swallowing. There was a marked and generalized swelling of the lymph nodes on the left side. The swelling was nontender, firm, and nonfluctuant. The skin was glistening and taut. There was no difficulty in opening the mouth. Examination showed a lesion extending from the left retromolar area around the mandible and base of the tongue into the right premolar region. The teeth in the entire left portion of the mandible and the anterior teeth were loose and carious. The tongue was swollen and indented from pressure against the lower teeth (fig. 2A). There was no

Figure 2 (case 6). Osteomyelitis and cancer of the mandible. (A) Cancer of the gum, tongue, and floor of the mouth. (B) Antero-posterior roentgenogram. (C) Lateral-oblique roentgenogram.

feeling in the lip on the entire left side and there was some numbness on the right. The roentgenographic findings were those of a fairly extensive osteomyelitis of the mandible accompanied by a malignant invasion, (fig. 2, B and C). The patient insisted that the pain and swelling began almost overnight. A physician had advised him to have his teeth extracted. He then consulted a dentist who refused to extract any teeth until the swelling subsided. As the swelling persisted and swallowing became difficult the patient went to the physician who referred him to this hospital. The biopsy specimen was interpreted by the pathologist as a grade 3 epidermoid carcinoma. It was believed that the patient was beyond cure. The pain was controlled with narcotics and the patient survived for almost 5 months.

Case 7. A 56-year-old man was admitted to this hospital complaining of pain in his abdomen and legs. He asserted that he had never had a serious illness and had felt well until about 10 weeks earlier. He was seen in the dental clinic 3 days after being admitted. The ward physician reported that there were several hard, movable, nontender masses below the umbilicus and in the left groin and a malignancy was suspected. Examination of the mouth revealed a small ulcer in the upper right molar area. A biopsy specimen was taken and was reported as adenocarcinoma of the gum. Shortly after this report a definite diagnosis of cancer of the gastrointestinal tract was made. The chief interest in this case was the determination of the primary site. Oral cancers metastasize into the lymph nodes and infiltrate into the viscera but with the exception of cancer of the larynx the reverse is rare. In this case the small size of the oral ulcer and lack of cervical lymph node involvement would seem to eliminate it as a primary lesion. The gastrointestinal cancer was highly malignant and because of the extent of the metastases only palliative treatment was given. The patient died 6 weeks later with a diagnosis of metastatic adenocarcinoma, primary site undetermined.

SUMMARY

The detection of oral cancer and precancerous lesions in the mouth is a definite responsibility of the dentist. A thorough examination together with a biopsy report is the surest method of establishing a diagnosis.

Field Hospital Neuropsychiatric Service[1]

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THIS report concerns the activities of the neuropsychiatric service of the 4th Field Hospital which served as the main psychiatric treatment center for United Nations' Forces in Korea during the months of November and December 1950.

Professional and other personnel assigned. When first organized, the service had one psychiatrist. It soon became apparent that one man could not handle the volume of work and an additional psychiatrist was assigned. Then as the service became the main psychiatric center in this theater another psychiatrist was added to the staff. It was found to be distinctly advantageous to have more than one psychiatrist, not only to prevent too great a work load on any one man but also to make possible the discussion of unusual cases. In this way better care to this type of patient was afforded. The three medical officers had all been in psychiatric residency (civilian and Army) before being called or recalled to active duty in this theater. Each also had some experience with psychiatric cases at station hospitals in Japan before coming to Korea. In addition a nurse was assigned to the service during October and November, but it was found to be an unnecessary luxury for the patients. Because the assignment of a nurse tended to play up the hospital atmosphere and increased the possibility of secondary gain from neurotic illness no nurse was assigned to the service in December. Four enlisted men with varying periods of training in neuropsychiatric work were assigned to the service. During the morning two medical technicians were on duty, and during the later two periods of the day one medical technician was on duty. The medical technicians were responsible for the assignment of beds, insistence on shaving, showering, and eating, administration of routine medications, and observations on sleep, eating, and behavior of patients. The chief psychiatric consultant for the Far East Command made several visits to the service during the period of

[1] Adapted from the Surgeon's Circular Letter, Far East Command, Vol. 6, No. 3, 1 Mar. 1951, p. 48 - 52.

operation, and saw and discussed patients with psychiatrists. During these visits he also held consultations for the other services.

Organization of wards. The wards of the psychiatric service were separate from the medical and surgical wards. This was believed to be necessary because of the so-called infectiousness of some psychogenic symptoms. The psychiatrists had separate small offices in the same ward section. The patients slept on Army cots and usually made their own beds. Food was not served on the ward, all patients being encouraged to go to the mess hall for meals. The wards were located in permanent-type buildings and there was adequate heat. At no time were we limited in number of beds or in length of hospital stay. An attempt was made to segregate patients going to limited duty, full duty, and to Japan for evacuation. This, however, proved to be impractical because of the short period of hospitalization. In general, interviewing and treatment were carried on in the private offices. Patients sent for consultation from other services were seen on the psychiatric service, unless they were confined to bed.

Types of patient seen. It soon became apparent that the type of patient seen when troops were engaged in active combat differed from that seen when there was a break in activity. During combat with the enemy there was an upswing in the number of moderate and severe anxiety reactions and in conversion reactions, but in the periods between combat more patients with other neurotic reactions, psychotic reactions, character disorders, and immaturity reactions were seen. The approximate distribution was 70 percent neurotic reactions, 10 percent psychotic reactions, 12 percent character disorders and immaturity reactions, 2.5 percent neurologic diseases, and 5.5 percent no disease found(including poorly motivated soldiers and normal combat reactions). The average number of daily admissions varied depending on the tactical situation, availability of transportation from the front, number of surgical casualties who had to be evacuated first and availability of beds held for the division psychiatrists at clearing stations. In general there were from 10 to 30 admissions daily. During the latter part of November when Chinese forces began an all-out offensive, the number of admissions increased sharply. Usually there was a lag of from 2 to 5 days between the arrival of surgical and psychiatric casualties during active combat. Anxiety reactions were, by far, the most frequent entities seen, with conversion reactions next in frequency.

It was soon learned that the symptomatology of the anxiety reactions was of little importance. It varied from patient to patient, but almost universally the conflict was close to, if not at the level of consciousness. This conflict seemed always directly to involve the combat situations and the dangers to the soldier inherent to this situation. The therapist could quickly "peel away" the symptom layer, and could discuss directly with the patient the conflict of which the patient was at least partly aware. In some perfectionistic, compulsive patients defenses would quickly break down under the conditions of battle which

did not lend themselves to perfectionism, and these persons would then develop a tremendous amount of anxiety. But in general the anxiety reaction was seen in those who were not of necessity compulsive, and who had been exposed to a considerable amount of combat. The backgrounds and family life of these patients varied greatly.

The severe anxiety reaction was usually found in a patient who had considerable combat in this campaign (and sometimes in World War II as well). He would usually come in looking very tired with his face drawn and expressionless or full of terror. Tremulousness, vocal difficulty, dilated pupils, rapid pulse, profuse sweating, tremors, and sometimes lacrymation were seen. The subjective complaints usually included insomnia, anorexia, more than the usual weight loss, battle dreams (which seemed always to be attempts at mastery of a situation in which the patient believed he had failed). Usually there was an immediate precipitating factor, such as the death of a friend, or the inability to remove one of the wounded of his platoon while under fire, which assumed great importance in such patients. Usually the neurotic symptoms did not appear until after the patient was removed from danger. This protective mechanism has also been noted in the other psychiatric syndromes. The symptoms of the less severe anxiety reactions were similar but milder, and were frequently seen in soldiers who had gone into combat for the first time.

In the perfectionistic officer or soldier, when the psychologic defenses break, depression often becomes part of the anxiety reaction. Typical of this type of reaction was a 25-year-old platoon leader who was admitted with marked apathy, anorexia, psychomotor retardation, and constipation. He said: "War is hateful, useless, terrible—I'd like to evacuate my whole platoon. Poor boys, I'm a misfit; I should have taken one of my wounded out, but I couldn't because of the shooting. He died. I'm no officer!" This patient had "straight A's" in college, had been an excellent infantry lecturer, had been a pride to his outfit in the United States, and had done well on maneuvers. When he finally became a platoon leader after 3 months in Korea, the difficulties of combat broke his defenses down and his punishing superego took over with resultant severe anxiety symptoms and depression.

Conversion reactions as well as anxiety reactions almost always developed after the danger had passed. Many gross hysterical phenomena including total paralysis of both lower extremities, blindness, deafness, or amnesia were seen and all patients seemed to have a moderate to a great amount of indifference to their symptoms. These seemed to occur frequently in passive individuals after their first show of hostility. Typical of this was a 20-year-old soldier who came into the hospital after being treated for an upper respiratory infection for 1 month because of inability to talk above a whisper. He revealed under amytal that just prior to the development of aphonia he had killed some enemy soldiers (for the first time). This apparently disorganized his passive defenses,

allowing a conflict to break through with resultant aphonia. He was quite passive and said, "I always walk away when I'm angry; that's best."

Surprisingly, a large number of the psychotic reactions seen were in base troops or troops who had been in Korea but a short time. The symptoms were those of the usual psychotic reactions as seen elsewhere. Minimal stress in these patients either accentuated an already existing psychosis or tended to push the markedly regressed person into psychosis. A 26-year-old soldier who had been in Korea 2 weeks came into the hospital complaining, "I have to go to the latrine often at night to urinate." It was found that this man had been responding to auditory hallucinations rather than urinary urgency. The voice was usually that of his grandmother, long since dead. This patient had been raised by a domineering mother and a passive father who never allowed him to have dates or go out of town. He had been rejected by the draft boards in World War II on several occasions, and had made fair adjustment in a box factory for several years. He had made a marginal adjustment during a year of active duty in the Army in the United States after which he was discharged. He was recalled in November 1950 from the enlisted reserve and hearing he was going to Korea, he developed intense fear and, "heard many strange voices on shipboard due to my seasickness." On admission the patient had flat affect, silly laughter, auditory hallucinations, irrelevancy, withdrawal from others on the ward, and his condition was diagnosed as a schizophrenic reaction.

Among the group labeled "No disease found" were several patients with the normal combat reaction. These showed minor sleep difficulties at the front, tremulousness, anorexia, apprehension, and other symptoms. When they were acquainted with the fact that most of their buddies had these symptoms they were relieved, and after a good night of sleep were quite willing to return to combat. Also in this group were patients with one or more subjective complaints and almost no anxiety. Typical of such persons was a 22-year-old aidman who complained of "night blindness." When questioned, it was found that he could not see in the field on dark nights when flashlights were not allowed. Except for mild myopia, his eyes were normal. He had lived in Boston most of his life and had no occasion to walk around without lights and was never particularly aware of the difference in ability to see at night without lights. He could see perfectly well in the field with a flashlight, or when the moon was full. He was introduced to these factors, and being a well-motivated soldier, he soon went back to duty.

Being at an Army level, in addition to getting patients from division clearing stations which were the usual sources of patients, the service also received patients from base units. Many of these were character disorders, and all were returned to their units for administrative handling, rather than being allowed to clog medical channels.

Types of interviews and treatment. Each patient was seen on his first hospital day and each day of hospitalization by his own psychiatrist.

Usually only one psychiatrist saw the patient but sometimes he was seen by two. Usually during the initial interview, which lasted from 15 to 30 minutes, the psychiatrist would listen to the patient's history and after this was obtained, he would attempt to have the patient disclose the conflict quickly by questioning which was directed toward the minimizing of subjective complaints. Once the veneer of symptomatology was removed, the patient's fear of combat, anger at a superior, or feeling of inability to do a job for which he may not have been well suited were discussed with him. Great emphasis was placed in this form of brief, directive psychotherapy on the current situation rather than on an often unreliable past history (which patients frequently exaggerated to make it appear that they had a lifelong neurosis). This type of therapy, drawing forth the feelings of the patient in relation to current events, was continued on the following day or two of hospitalization.

With this treatment, anxiety frequently lessened or disappeared as the patient began to understand what he was really concerned about. This therapy was effective at this level because rapid evacuation inhibited a complete establishment of the neurosis. The conversion reactions were treated by means of strong suggestion, or abreaction usually under amytal narcosynthesis. Coramine in large doses was used to a great extent following amytal, in an attempt to have the patient wake rapidly following the abreaction. We were not overly impressed with the results following the use of coramine. Almost all conversion reactions became asymptomatic under this form of treatment and most patients could at least be returned to noncombat duty if not to combat duty. When the defense afforded by the conversion was removed, almost all patients, rather than becoming gratified at being able to walk or see, would become hostile toward the therapist. This would usually pass off or decrease before the patient returned to duty.

Included in treatment was a routine insistence on cleaning up, shaving, and eating within the first 6 to 12 hours. In psychotics and patients with severe anxiety reactions, amytal sedation was used the first night starting with 0.4 gram and repeating if necessary to insure restful sleep. In general, sedation was used sparingly and was never routinely ordered. Frequently a patient with a moderate anxiety reaction looked much improved after he merely cleaned up and had a good night's sleep. Brief outpatient psychotherapy was attempted with several patients from base units. The emphasis in the interview and therapy was always on the current situation in combat and what was happening in the interpersonal relationship between patient and doctor. The patient was not allowed to use the cloak of symptoms without exploration of the conflict. We are much encouraged by our results using this form of psychotherapy.

Advantage of being part of a field hospital. Having a main treatment center operate as part of a field hospital in a combat theater was different from the usual practice in World War II in which independent psychiatric

treatment centers were set up. By so operating, liaison with the medical and surgical services was gradually established so that about 7 consultations were being sent to the psychiatrists daily. In addition, there were always consultations from outside units. Some of the "mysticism" frequently cloaking psychiatric work in the minds of other doctors was removed by having psychiatric patients on their own wards whose problems they were able to discuss freely with the psychiatrists. It is believed that teaching the principles of psychiatry and psychosomatic medicine to the medical officers on the other services was both an appreciated as well as an important function of this psychiatric service. The importance of situational and psychogenic factors in causing illness was thus seen by the other medical men through consultations about their own patients. As a result of this liaison, the other medical men developed greater facility in diagnosing, treating, and returning to duty those on their own services who had psychologic factors in their illness. Numerous unofficial conferences between the other medical officers and the psychiatrists were held in relation to psychogenic factors in illness. An indication of the awareness by the other medical officers of psychogenic factors in illness was the fact that well over 150 consultations were held in the month of December. We became well aware of the fact that the admission rate of patients to a psychiatric treatment center in no way reflected the large incidence of disease of psychologic origin, for the medical and surgical services saw large numbers of self-inflicted wounds, "cold feet," gastrointestinal reactions and other psychosomatic diseases.

Liaison with division psychiatrists. Almost all psychiatrists in Korea were known to one another, and the division psychiatrists would occasionally come to the 4th Field Hospital where mutual problems could be discussed. In this way those of us on the psychiatric service at the 4th Field Hospital knew and appreciated some of the problems and difficulties of the division psychiatrists. For example, some of the division psychiatrists at times had a difficult time obtaining sufficient holding beds in clearing stations. We were aware of increased admission rates from divisions at these times. This of course played a part in our record for returning large numbers of patients to duty. If the division psychiatrists had been able to hold patients longer in some instances they would have been able to return them to duty before they reached this level.

Days of hospitalization and disposition. The average hospital stay of patients was 2 to 3 days. From 65 to 70 percent of them were returned to duty, of which about 45 percent went to full duty and the rest to limited duty. About 10 percent went to Pusan or to a hospital ship during early December when the situation was so fluid that any patients needing more than one day of hospitalization (about 23 percent) were evacuated to Japan. Among the factors influencing the large number of returns to duty as compared to those in World War II, was the fact that although the treatment center was often 200 miles from the front, the

rapidity of transportation by air was such that there was no long slow trip back to a treatment center behind the division clearing stations. This time could have been adequate for the fixing of some symptoms. Also because the discomforts are inherent to *all* parts of Korea, combat area or not, secondary gain factors were lessened. Lastly, the stay of only 2 or 3 days in the hospital decreases the time during which secondary gain might develop.

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Oral Rehabilitation

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ORAL rehabilitation may be defined as the restoration of the jaws, muscles, and teeth to a normal relationship and the rebuilding of the existing occlusion to a harmonious pattern *(2,3)*. From this definition it can be seen that we are interested in more than just the replacement of a missing tooth or the filling in of edentulous areas. The mouth must be considered as a whole and in relation to the rest of the body since it has a definite function to perform in the digestive process. We now recognize that the harm caused by the loss of one or more teeth is not limited to the dental apparatus, but may result in impaired hearing, frequent headaches, temporomandibular joint disturbances, and gastrointestinal disturbances.

Complete oral rehabilitation is a complex part of prosthetic dentistry requiring a knowledge of every phase of dentistry. It involves long and tedious procedures which are trying to both patient and dentist. The patient should be fully informed of the difficulties of the task and must be willing to accept the final out-come. In no event should the dentist give any guarantee as to the success of the undertaking. This type of work should not be attempted on patients who are high strung or very tense.

Before any work is begun, a thorough study of the case must be made so that an accurate diagnosis and treatment plan can be presented to the patient. This should include:

1. A complete set of radiographs including bite-wings. These will give us a great deal of information as to the size, shape, and position of the roots and also the condition of the supporting structures of the teeth. Those teeth with bifurcation and trifurcation involvement should be removed, as should teeth which have lost more than one-half their bone support. Infected teeth which cannot be treated successfully by endodontic or surgical procedures should also be removed. All cavities should be filled before any of the other work is begun. Because extensive reconstruction is comtemplated, doubtful teeth should be ex-

(1) Camp Gordon, Ga.

(2) Schweitzer, J. M.: Restorative Dentistry. The C. V. Mosby Co., St. Louis, Mo., 1947. p. 237.

(3) Tylman, S. D.: Theory and Practice of Crown and Bridge Prosthesis. 2d edition. The C. V. Mosby Co., St. Louis, Mo., 1947. pp. 909-910

tracted beforehand rather than having them cause trouble after the treatment is completed.

2. A set of study models and a duplicate set of visual models should be constructed. The study models will provide a good picture of the mouth and existing occlusion and thus aid in making a proper diagnosis. The visual models are used to show the patient what is to be accomplished and what the finished case will look like. If gold will be visible the model can be painted with gold paint. Teeth which are to receive jackets can be rebuilt with white wax. Posterior teeth which are to be built up can be shown with inlay wax.

3. The mobility of all the teeth should be determined and recorded. This should be done with a mirror and explorer or other instruments rather than the operator's fingers in order to obtain a truer picture. Mobility is classified as follows *(4)*:

A *number 1 mobility* is applied to those teeth which can be moved buccolingually about 1 mm.

A *number 2 mobility* is applied to those teeth which can be moved more than 1 mm. but cannot be depressed or rotated in their sockets.

A *number 3 mobility* is applied to those teeth which can be depressed and rotated in their sockets. Such teeth should be removed.

4. Vitality tests should be made on all suspicious teeth and teeth with large restorations.

5. The condition of the gums and supporting structures must be carefully noted because most of the patients will show some degree of periodontal disease..

6. The general health and occupation of the patient should be taken into account.

7. The type of occlusion present should be determined. In rehabilitation work, occlusion is classified *(5)* as:

(a) *Normal overbite.* In this bite, the incisal edges of the upper teeth overlap the lower teeth slightly and the mandible can go through its various excursions with ease.

(b) *Deep overbite.* In this type of bite the incisal edges of the upper teeth overlap the lower teeth to a great extent, sometimes obliterating them from view when the teeth are in centric relation.

When we are dealing with a deep overbite *(3)*, we must determine whether it is caused by an over-eruption of the anterior teeth, an under-

(4) Miller, S. C.: Textbook of Periodontia. 2d edition. The Blakiston Co., Philadelphia, Pa., 1943. Chap. 4, p. 103.

(5) Miller, S. C.: Oral Diagnosis and Treatment Planning. The Blakiston Co., Philadelphia, Pa., 1943. pp. 163-165.

eruption of the posterior teeth, or a combination of both. If it is caused by an over-eruption of the anterior teeth, we can usually correct it by judicious grinding of these teeth. If it is caused by the failure of the posterior teeth to erupt sufficiently, then we must build these teeth to such a plane that they can move freely in the various mandibular excursions, but we must be careful not to impinge on the freeway space.

(c) *The prognathic bite.* This is usually treated by increasing the vertical dimension so that we will have freedom in lateral excursion.

(d) *The edge-to-edge bite.* This type of bite is caused by attrition and in most instances lends itself well to rehabilitation procedures because it is usually associated with excellent bone support. We must be sure, however, that we maintain the edge-to-edge bite in the finished case or we are doomed to failure. Any attempt to convert this type to an overbite will result in labial movement of the anterior teeth accompanied by bone destruction and early loss of these teeth.

We have heard the term bite-raising used frequently. This is a misnomer. We do not raise the bite because by doing so we interfere with the freeway space. We do restore lost vertical dimension within the limits set by the freeway space.

It would be well here to explain and define some of the more important terms used in rehabilitation so that we will understand what the freeway space represents and how we can determine it.

Centric relation is that relationship existing between the upper and lower jaws when the mandible is in its most retruded unstrained position with the heads of the condyles in the glenoid fossas at any given opening from which lateral movements can be made.

Centric occlusion is that relationship existing between the upper and lower jaws when the teeth are closed so that maximal occlusal contact is obtained. This is a comfortable position which the patient habitually assumes over a period of time and it may or may not be the same as centric relation.

Rest position is the position of the mandible when it is involuntarily suspended by the reciprocal coordination of the muscles of mastication and the depressor muscles with the upper and lower teeth separated *(6)*. This position is constant throughout life and is the point from which all mandibular movements begin, therefore it is the logical position from which to analyze any malrelationship of the jaws and malocclusion of the teeth.

The freeway space is the difference between the rest position and centric relation. It usually averages about 3 mm. in the central incisor region.

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(6) Niswonger, M. E.: Rest position of mandible and centric relation. J. Am. Dent. A. 21: 1572-1582, Sept. 1934.

Any attempt to interfere with the freeway space by raising the bite will result in failure because the patient will develop clamping and grinding habits causing the teeth to be depressed in their sockets with possible resultant periodontoclasia. Because the rest position and the freeway space are so important to us, we must be able accurately to determine these positions if our treatment is to be successful. There are two methods by which we can make these determinations (7).

The roentgenographic method requires great skill and expensive equipment and is therefore limited in its use. Many dentists claim that this method is not accurate because it is difficult to obtain good plates of the temporomandibular joint for purposes of measurements.

The clinical method on the other hand, although not as scientific, requires little equipment and only a little practice and patience. The patient is seated erectly without the use of the headrest and is asked to repeat the letter M. We observe the position of the mandible at the conclusion of the sounding while the lips are slightly parted. This is the rest position of the mandible. The lips can then be gently parted and the amount of freeway space observed. This procedure should be repeated until we are certain that our determination is correct. Now we are ready to fix this position so that we can transfer the relationship to an articulator. With the mandible in the rest position, a small amount of fast-setting plaster is placed between the anterior teeth. When this hardens, the procedure is repeated in both posterior regions. The 3 indexes are then removed from the mouth, placed on our models and the case then mounted on the articulator.

We are now ready to make a diagnosis and plan the treatment. Before beginning the restorative work, we must equilibrate the existing occlusion. Many cases which seem to be difficult will present an entirely different picture after this has been done. The procedure to be followed in the equilibration of the existing occlusion is briefly as follows (8):

1. We first correct premature contacts in centric occlusion. If the contact is in centric only, then the fossa is deepened. If the prematurity exists in lateral excursion as well as centric, then the cusp is ground.

2. Next we grind premature contacts in protrusive position. We try to have as many anterior teeth in contact as possible in this position. If we get some posterior contact so much the better, but we do not grind the anterior teeth for the purpose of obtaining posterior contact in this position. We also shape the anterior teeth for aesthetic purposes.

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(7) Thompson, J. R.: Rest position of mandible and its significance to dental science. J. Am. Dent. A. 33: 151-180, Feb. 1946.

(8) See Chap. 10 of footnote reference (4).

3. The third step is to remove premature contacts in protrusive relation so that we have a free movement from centric to protrusive relation. Our grinding is confined to the area from, but not including, centric contact to the incisal edges of the upper teeth, otherwise we may disocclude the teeth in centric occlusion. We follow the rule BU-LL which means grind the buccal surface of the upper and the lingual surface of the lower teeth.

4. The last step in the procedure is grinding in lateral excursions and for this purpose we also follow the rule BU-LL. It is advisable but not imperative that contact be obtained on the balancing side, but on the working side contact is imperative. We do not have to have a three point contact as in grinding artificial dentures.

The equilibration should be accomplished in several visits and grinding should be done conservatively because a great deal of damage may result from too much grinding. We are now ready to begin the reconstructive work. It is not my purpose in this article to describe any definite technic because that varies with each case but the following points are important: (1) we usually start with the lower jaw, establish an even plane of occlusion at the desired height and build the upper teeth to meet the lower; (2) we must distribute the stress over as many teeth as possible in each excursion; (3) our abutments are either three-quarter crowns or some type of full coverage; (4) inlays are never used as abutments; (5) cantilever bridges are never used except in replacing a lateral incisor; (6) splinting of teeth is used if periodontal involvement is present; (7) pontics are given a bullet-nosed shape so that food can be easily pushed through; (8) posterior restorations and abutments are constructed at a reduced buccolingual diameter so that the stress of mastication is brought further over the center of the root because that is where the tooth can withstand the greatest amount of strain; (9) the height of the cusps is determined by the age of the patient, but usually we do not exceed a 20° cusp or we may have interference in lateral excursions; (10) never restore lost vertical dimension on partial dentures only—a fixed stop must be provided; (11) gold biting surfaces are used on posterior teeth and we should have enough thickness to allow for any grinding which may be necessary; (12) periodontal treatment is necessary before, during, and after the work; and (13) we must impress on the patient the importance of home care and periodic checkups.

Congenital Facial Diplegia

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THE syndrome of bilateral facial paralysis is well known and many cases have been reported in the literature. The bilateral weakness is quite variable in extent and it is most frequently associated with anomalies of the other motor cranial nerves, particularly the nerves of the extraocular muscles. The combination of facial weakness and extraocular muscle weakness has been called Möbius's syndrome. This syndrome, in addition to the facial diplegia includes paralysis of the extraocular rotator muscles. Thomas *(1)* and Bonar and Owens *(2)* pointed out that a pure facial weakness without other anomalies of nonobstetric origin was quite unusual.

Henderson *(3)* was able to find only 61 cases of the syndrome. The extent of complete facial paralysis was studied in this series and it was noted that out of the whole series only 19 patients had complete paralysis of all quadrants of the facial musculature; 13 had complete paralysis of only the upper quadrants; and only 1 had complete paralysis confined to the lower quadrants. Three had complete paralysis of only one side of the face and 10 had no complete paralysis of the facial musculature. Of these 61 patients 45 had associated bilateral paralysis of the abducens nerve; 15 had involvement of the oculomotor nerve; 18 had weakness of the hypoglossal nerve; and 4 had involvement of the trigeminal nerve. The 4 patients with weakness of the trigeminal nerve had only partial weakness and this was of a minor degree, interfering only in lateral motion of the jaws. Danis *(4)* found 21 cases in the literature in addition to those cited by Henderson and added 1 of his own. None of these showed any involvement of the trigeminal nerve. Hicks *(5)* and Murphy and German

(1) Thomas, H. M.: Congenital facial paralysis. J. Nerv. & Ment. Dis. 25: 571-593, 1898.

(2) Bonar, B. E., and Owens, R. W.: Bilateral congenital facial paralysis; review of literature and classification. Am. J. Dis. Child. 38: 1256-1272, Dec. 1929.

(3) Henderson, J. L. (Edinburgh): Congenital facial diplegia syndrome; clinical features, pathology, and aetology; review of 61 cases. Brain 62: 381-403 Dec. 1939.

(4) Danis, P.: Les paralysies oculo-faciales congenitales. (A propos de trois observations nouvelles.) Ophthalmologica 110: 113-137, Sept.-Oct. 1945.

(5) Hicks, A. M.: Congenital paralysis of lateral rotators of eyes with paralysis of muscles of face. Arch. Ophth. 30: 38-42, July 1943.

(6) reported 5 more patients with congenital facial diplegia, 1 of whom showed some involvement of the trigeminal nerve. This was expressed only by slight deviation of the jaw with no weakness of the masseter muscle.

CASE REPORT

Soon after the birth of a 9-month-old girl, whose delivery was by low forceps, it was noted that she had difficulty in feeding because the mouth could not be closed voluntarily. Following the delivery, which was not difficult, there were no marks of trauma. The birth weight was 7 pounds, 3 ounces. The baby soon learned to nurse in spite of her handicap by using the tongue, and later would use the hands to push the lower jaw upward to close the mouth. General development as to intelligence, weight, and learning were normal. There was no family history of anomalies. Physical examination revealed deep temporal fossas. There was a bilateral weakness of the abducens nerve with nystagmus on looking to the side. Bilateral epicanthus was present but no ptosis was noted (fig. 1). The baby could close

Figure 1.

the eyes but there was marked weakness of the facial muscles bilaterally. The tongue was normal. The jaw could not be closed voluntarily and no masseter muscle could be palpated. The corneal reflex was present on the right side but absent on the left. The baby had been occasionally noted by the mother to pull up the right corner of the mouth slightly. Innervation to this part of the face was confirmed by electric stimulation. Faradic stimulation could produce contractions of the muscles of the right side of the face, both upper and lower groups. Neither strong faradic nor galvanic stimulation could produce any response in the muscles of the left side of the face or of any of the muscles of mastication. Roentgenograms of the skull, spine, and pelvis were normal. The electroencephalogram was normal.

(6) Murphy, J. P., and German, W. J.: Congenital facial paralysis. Arch. Neurol. & Psychiat. 37: 358-361, Mar. 1947.

DISCUSSION

The case presented here is considered unusual in that there is complete bilateral paralysis of the muscles of mastication. The literature reveals out of a total of 88 reported patients with congenital facial diplegia only 5 in whom there was trigeminal involvement, and in all it was only of a minor nature, not interfering seriously with mastication. Other anomalies of the body are frequently associated with the facial diplegia. Henderson's review included 19 patients with clubfoot; 13 with deformity of the upper extremity; and 8 with a pectoralis muscle deformity. Schapringer *(7)* found such additional anomalies as a protuberant glabella, bilateral epicanthus, deformity of the terminal phalanx of the left index finger, bifid uvula, and a sunken sternum. Fry and Kasak *(8)* found associated with their patient an anomaly of the left hand, an absent left breast, and a family history of congenital anomalies. Hicks noted web fingers in one of his four patients. Gifford *(9)* found defective sternocleidomastoid and scapular muscles. My patient revealed no anomalies other than bilateral epicanthus.

Henderson, Danis, and Bonar and Owens concluded after their respective reviews that congenital diplegia is characterized by small or absent motor nuclei for the facial nerve and associated anomalous cranial nerves with small or absent nerve roots. These conclusions, however, are based essentially on one report by Heubner *(10)* of an anatomic examination of a patient with congenital diplegia who came to autopsy. The patient reported by Murphy and German is of interest in that an air encephalogram was performed. This revealed enlarged basal cisterns, particularly the cisterna pontis, cisterna interpeduncularis, and cisterna chiasmatica. The distance from the ventral margin of the pons to the floor of the fourth ventricle was less than normal. These findings suggested hypoplasia of the pons and brain stem. Apparently the primary process resulting in the syndrome is agenesia of the motor nuclei of the cranial nerves involved. What factors are present to produce such agenesia remain unknown.

(7) Schapringer, A.: Case report, Boston M. & S. J. pp. 635-636, 1889.
(8) Fry, F. R., and Kasak, M.: Congenital facial paralysis. Arch. Neurol. & Psychiat. 2: 638-644, Dec. 1919.
(9) Gifford, H.: Congenital defects of abduction and other ocular movement and their relation to birth injury. Am. J. Ophth. 9: 3-22, Jan. 1926.
(10) Heubner, O. (1900): Cited in *(2 - 5)*.

Sacrococcygeal Teratoma

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TERATOMAS of the sacrococcygeal area constitute an interesting group of tumors and although they are not rare, the occurrence of malignancy in them is an important factor to consider in their treatment. In the case to be reported malignancy was demonstrated.

CASE REPORT

At birth this girl had a small mass at the base of the spine and an adjacent but separate mass in the right buttock. The opinion, when she was 1 month of age, was that the mass at the base of the spine represented a meningocele and that no surgical intervention was indicated for a period of from 6 to 12 months. No record was made of the initial impressions concerning the mass in the buttock. At 2 months of age, the child developed meningitis and was readmitted to the hospital for treatment. No organisms were recovered from the spinal fluid and, although it was thought that this meningitis was probably secondary to infection of the mass in the buttock, aspiration yielded no pus. At this time also a cord bladder was noted which required an indwelling catheter. The mass at the base of the spine was the size of a walnut, blue-gray, and fluctuant. A dye injected into the lumbar subarachnoid space was recovered by aspiration from this mass. A portion of the mass in the buttock 1 cm. in diameter was removed for microscopic examination.

Considering the size and location of the mass in the buttock, the presence of the meningocele, and the child's general condition, surgical removal was believed contraindicated so the child was returned to her parents. She developed a persistent urinary tract infection, bilateral edema of the legs, and gradual increase in the size of the mass in the buttock. Firm subcutaneous lumps appeared over the back when she was about 18 months of age and a roentgenogram of the chest taken when she was 20 months of age revealed nodular densities scattered throughout both lungs which were interpreted as metastatic lesions. Marked emaciation developed and the child died at 2 years of age.

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Laboratory data during this child's hospitalization were not contributory other than to reflect the urinary tract infection, meningitis, and a gradually progressive anemia.

Gross pathologic findings. At autopsy the large ulcerated mass (fig. 1) was removed from the right buttock with difficulty and found to consist of soft, pale gray tissue intermixed with numerous small pockets containing thick creamy and hemorrhagic fluid. The mass was not encapsulated and had destroyed much of the sacrum, iliums, and lumbar spine and had extended into the retroperitoneal area of the pelvis and abdomen with marked displacement of organs although there was no actual invasion of them nor was seeding present on the peritoneum. The tumor had invaded the inferior vena cava and pelvic veins, but

Figure 1. Photograph showing the mass in the buttock and marked emaciation of the child at time of death.

not the aorta. The presence or absence of spina bifida could not be ascertained. There were metastases to the pelvic and abdominal parietal lymph nodes, the liver, and the lungs. The spinal cord below the lower thoracic region was surrounded extradurally by tumor without actual invasion and the cauda equina was inseparably enmeshed in tumor tissue. The metastatic lesions in the lungs and liver were well circumscribed and necrosis was present only in the larger lesions. No other source of tumor, other than the lesion in the buttock, could be demonstrated.

Microscopic findings. The biopsy specimen (fig. 2) consisted of neural tissue intermixed with varisized trabeculas of well vascularized connective tissue. The neural element was identified by the presence of neurons and neuroglia. The neurons had large, round, vesicular nuclei each containing a large nucleolus and a distinct nuclear membrane. The cytoplasm contained varying quantities of Nissl substance. The

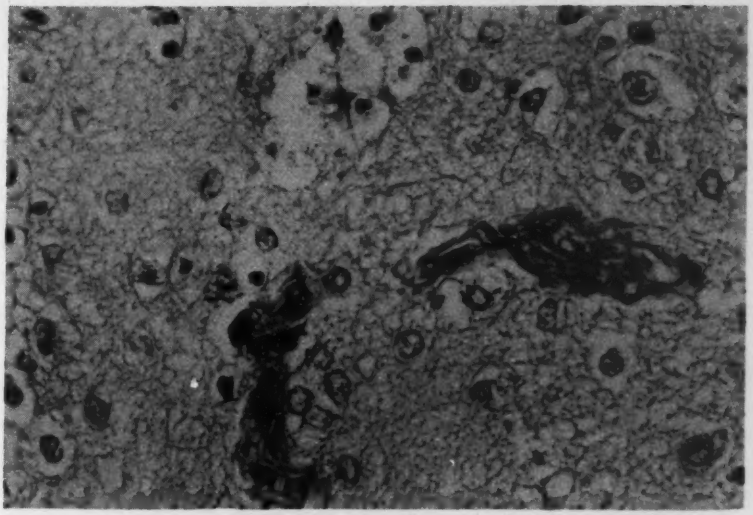

Figure 2. Section of biopsy specimen showing neural elements and the fibrous trabeculas.

cell bodies varied in size and shape and processes were present. The neuroglia were identified as astrocytes, oligodendroglia, and microglia. The astrocytes had large, oval, pale, vesicular nuclei; the oligodendroglia had smaller, more darkly staining nuclei and a clear cytoplasm. The fibrous trabeculas were of varying lengths and widths and contained rounded, contoured, purple, crystalline bodies. The ependyma was not identified with certainty. Large and small rounded spaces were seen, surrounded by flattened histiocytes, and foreign body giant

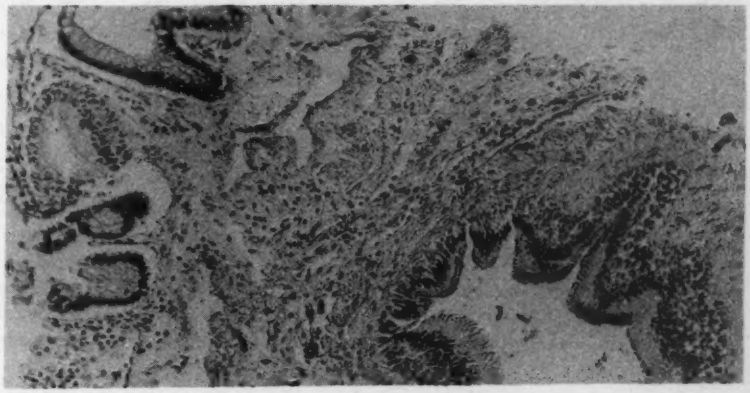

Figure 3. Section from autopsy specimen showing stratified ciliated columnar epithelium and mucus-producing glands.

cells were present around the smaller spaces. Fat stains proved the presence of lipid within these spaces. Some sections of the main mass in the buttock were similar to those prepared from the biopsy specimen, with the exceptions that fibrous trabeculas were more numerous, larger, and sections of the autopsy specimen showed much greater postmortem autolytic change. In addition, ductlike and cystic spaces lined by stratified ciliated columnar epithelium, stratified squamous epithelium, or mucus-producing epithelium were present (fig. 3). Other sections presented an entirely different appearance. There was a cellular tissue which presented a varied pattern, occurring either in solid sheets, or as a beaded, lacelike, alveolar, ductal, or papillary growth (fig. 4).

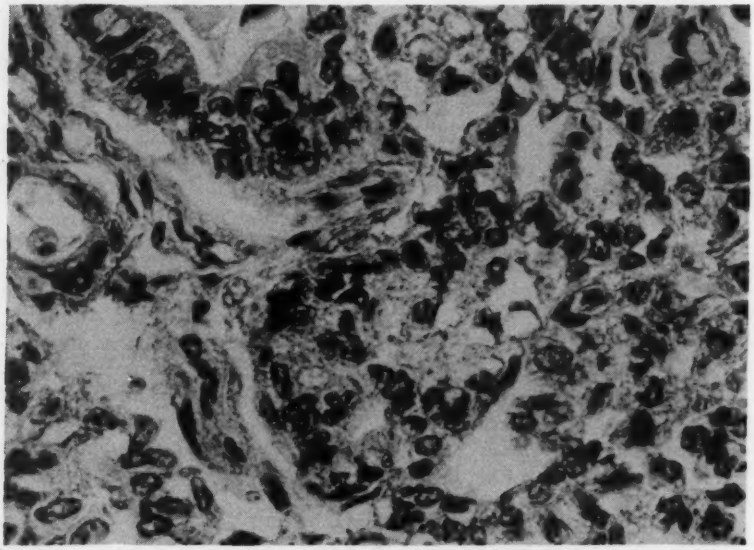

Figure 4. Malignant element of the tumor.

There was necrosis in the solid areas with central loss of tissue. Perivascular cuffing was occasionally present, but no true rosettes were found. The cells extended along fibrous septums generally respecting these barriers. The cells had indefinite cytoplasmic borders; stained slightly basophilically; and had oval, large, vesicular nuclei without nucleoli. When the ductal pattern was present the cells were columnar or cuboidal. There was slight cellular and nuclear variation. No hyperchromatism was present and mitoses could be found, but were not numerous. No intracytoplasmic nor intranuclear inclusions were demonstrated. The metastases were similar in appearance to the main tumor.

COMMENT

The malignant element was very suggestive of ependyma both in cellular morphology and growth pattern, but blepharoplasts could not be demonstrated. Gross et al. *(2)* in a report of 40 sacrococcygeal teratomas in infants and children found that 11 exhibited histologically malignant characteristics. Riker and Potts *(3)* in a report of 6 cases of sacrococcygeal teratoma reported malignancy and recurrence in 2 and probably in a third. Lisco *(4)* reported 2 cases with malignancy and collected 10 similar cases from the literature.

In the 12 cases analyzed by Lisco *(4)* metastases occurred to the lungs in 8, to lymph nodes in 8, and to the liver in 5. The type of malignancy was described as papillary adenocarcinoma in 6, adenocarcinoma in 2, carcinoma in 1, embryonal carcinoma in 1, alveolar sarcoma in 1, and chondrosarcoma in 1. All died within about 3 years of birth. In those cases reported by Gross et al. which exhibited histologically malignant characteristics, 7 had evidence of invasion or metastases. The sites of metastases were not broken down statistically, but they were to lymph nodes, liver, lungs, or distant bones. Histologically the malignant elements were classified as embryoma in 4, papillary adenocarcinoma in 4, as malignant neural tissue or neuroblastoma in 2, and rhabdomyosarcoma in 1.

In comparing this case with the others it is probably best classified as adenocarcinoma and in its behavior fits well with the reported cases as a whole. If those cases classified as adenocarcinoma, carcinoma, or embryonal carcinoma could be studied and compared histologically they would probably be found to have a very similar cellular and growth pattern. It is striking how closely the malignant elements in those cases illustrated in the literature resemble one another. This case emphasizes the need for adequate early surgical removal of all teratomatous sacrococcygeal growths whenever possible and also stresses the observation made by Gross et al. *(2)* that recurrences are more likely in those teratomas composed predominantly of neural elements.

(2) Gross, R. E.; Clatworthy, H. W.; and Meeker, I. A.: Sacrococcygeal teratomas in infants and children. Surg., Gynec. & Obst. 92: 341-354, Mar. 1951.

(3) Riker, W., and Potts, W. J.: Sacrococcygeal teratomata in infancy; report of 6 cases. Ann. Surg. 128: 89-100, July 1948.

(4) Lisco, H.: Malignant tumors developing in sacrococcygeal teratomata. Ann. Surg. 115: 378-389, Mar. 1942.

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Herpes Zoster Following German Measles

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FOR some time a close relationship has been thought to exist between the viruses of chickenpox and herpes zoster. We therefore believed that our case of herpes zoster, which followed an attack of German measles, was unusual enough to warrant reporting.

CASE REPORT

On 30 March 1951 a 19-year-old Negro reported on sick call, complaining of headache and tenderness behind his left ear for the past 24 hours. The patient stated that 3 days prior to admission he had noted a tender swelling in his left axilla, which gradually disappeared as his headache developed. With the onset of his headache and tenderness behind his ear, he had noted a mild sore throat and some discomfort of his eyes.

Physical examination revealed mild, bilateral conjunctival injection; moderately enlarged, hyperemic tonsils; hyperemia of his pharynx; two small, slightly tender, left postarticular nodes; and a morbilliform rash of the upper anterior portion of the thorax. The rash was not easily seen, but could be demonstrated by a light held parallel to the surface of the chest. The patient's temperature was normal.

At the time of his admission, 5 cases of German measles had been diagnosed among the airmen of the base, and several cases existed among the dependents. The conditions to be differentiated in this patient were tonsillitis with pharyngitis, German measles, and infectious mononucleosis which was ruled out by a negative heterophile antibody report. The patient was placed on bed rest, given a soft diet and supportive therapy. As prophylaxis against severe tonsillitis, he was given 300,000 units of procaine penicillin, daily for 3 days. The day following admission, only a minimal conjunctivitis remained in the left eye

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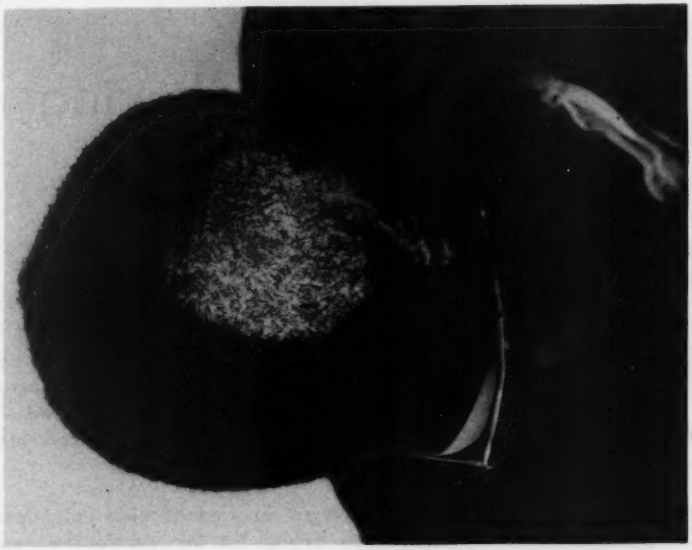

Figure 2.

Figure 1.

and the rash had almost completely faded. On the morning of the fourth day in the hospital his temperature, which had been normal since admission, rose to 101° F. and he complained of pain in his left eye and of his left eyelid. Herpes was considered. A consultation with a civilian ophthalmologist confirmed this diagnosis. Within 24 hours the patient developed typical blebs over the distribution of the frontal branch of the ophthalmic division of the trigeminal nerve. He was given 500 mg. of chloramphenicol every 6 hours. On the following day, the sixth day of hospitalization, the herpetic lesions were larger, his left eyelid was swollen shut, and he complained of pain on the surface of the left eye (fig. 1). Cortisone eyedrops were then given. Toward evening of the same day about a dozen vesicles were seen on the left side of the chest, roughly following the distribution of the intercostal nerves. By the eighth hospital day the herpetic lesions were drying and crusting. The patient no longer complained of pain in his eye. On the tenth day, he left on an emergency furlough. He was not seen again until 1 May when he reported on sick call complaining of pain in his right eye. He was immediately seen by an ophthalmologist, and a diagnosis of acute iritis was made. At that time it was also noted that there was ptosis of the left upper eyelid. This was considered a residual of the recent attack of herpes zoster. Scarring of the left cornea was also noted, and was also believed to be a residual of the herpes zoster. The patient was admitted to the hospital and given chloramphenicol and aureomycin. It was observed that in the 22 days between his discharge and his readmission, there had been a moderate loss of hair of the area previously involved with the herpetic lesions (fig. 2).

He was treated for 7 days. By the fifth day, most of his signs and symptoms had receded. He was discharged cured on the twelfth hospital day. At that time there was still a slight ptosis of the left eyelid and hyperpigmentated scarring of the left side of the forehead and left upper eyelid. The hair over the anterior left quadrant of the scalp had grown out almost completely.

CONCLUSION

Considering the vagueness surrounding the cause of iritis, it is postulated that after lying dormant for about 3 weeks, the patient had a recurrence of his herpes zoster. No relationship between herpes zoster and German measles is implied.

Use of Methergine in Vaginal Delivery[1]

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METHERGINE (methylergonovine tartrate), a semisynthetic ergot alkaloid, has been described pharmacologically and clinically by several authors in recent years. The opinions have been crystallized by Priver et al.[3] who stated that methergine has a more pronounced and sustained effect than natural ergonovine and that it is about twice as potent. Fifty patients were selected for this study, the only criteria being the presence of a single, full-term pregnancy in vertex presentation. Spontaneous, low forceps, and midforceps deliveries were included. Nitrous oxide-oxygen-ether anesthesia was employed in two-thirds of the patients, spinal anesthesia in one third, and 1 patient received sodium pentothal.

Method. One cubic centimeter of methergine was given intravenously simultaneously with the birth of the anterior shoulder, the needle having been previously inserted in an antecubital vein by a nurse or intern. Following this the observer placed a hand on the fundus and the time from the injection to the contraction of the uterus was noted. From 30 to 60 seconds were allowed to elapse for the birth of the remainder of the baby. The reason for this procedure was that the baby's body holds the lower uterine segment and cervix open, permitting contraction of the upper segment, the disproportion in size thus created facilitating the separation of the placenta. With the lower segment held open, the placenta rarely if ever becomes "trapped." It has also been shown that this uterine contraction may contribute to decreasing the amount of blood in the cord and placenta, thus making more blood available to the baby.

Other workers have shown that methergine is safe. Side reactions such as nausea, vomiting, and transient hypertension are significantly

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[2]Formerly Captain, MC, A. U. S.; now in Springfield, Mass.
[3]Priver, M. S., et al.: Intravenous use of methergine in intrapartum care. West. J. Surg. 57: 586-588, Dec. 1949.

minimized. In this series no other oxytocic drug was administered on the day of delivery, although the patients received 0.25 mg. of methergine by mouth t.i.d. for the first 3 postpartum days.

Results. The elapsed time from the birth of the baby to birth of the placenta ranged from 1 second to 4 minutes (table 1). In a few cases the placenta followed immediately on the baby's feet and in the remainder it was expressed with or during the first contraction aided by gentle traction of the presenting edge in the cervix.

TABLE 1. *Time required for delivery of placenta*

Number of minutes	0-½	½-1	1-2	2-4
Number of patients	3	7	16	24

The initial contraction of the uterus followed the intravenous dose in from 25 to 70 seconds. The largest blood loss measured was 275 cc. following a large mediolateral episiotomy. In the group of deliveries without episiotomy or with a small midline episiotomy the blood loss measured from 40 to 75 cc. (table 2). Episiotomy apparently is a large factor in the greater blood losses. No unusual side reactions were

TABLE 2. *Estimated blood loss*

Number of cc.	0-50	51-100	101-200	over 200
Number of patients	16	24	9	1

noted. Secondary relaxation of the uterus causing further blood loss was not seen.

CONCLUSION

Methergine apparently is a safe oxytocic and when used as described is an important factor in minimizing blood loss at vaginal delivery.

Violent or Clinically Unexplained Deaths

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IN THE Armed Forces, as in civil life, it is important to investigate thoroughly cases of violent or clinically unexplained deaths. In all such situations, many factors such as foul play, gross negligence, line of duty status, and public health have to be considered (2).

Fifty-nine cases of violent or clinically unexplained deaths were recently reviewed in this laboratory. These deaths occurred between 1 January 1950 and 31 July 1951. Deaths of adults only were included in the study. There were 21 deaths from injuries sustained in motor vehicle accidents, 11 from miscellaneous causes, 11 from diseases of the respiratory system, 11 suicides, 3 from neoplastic lesions, 1 homicide, and 1 from injuries sustained in an airplane accident.

The 3 clinically unexplained deaths caused by neoplastic lesions are of interest. The first case, a 17-year-old boy, entered the hospital complaining of pain and burning sensation of 4 months' duration in the substemal region. Percussion on admission revealed the heart to be enlarged to the left and a loud, harsh systolic murmur which was transmitted into the axilla was heard in the mitral area. Laboratory examinations were essentially negative. Roentgenograms of the chest showed the heart shadow to be within normal limits. The admission diagnoses were bronchitis and valvulitis. The patient was treated with antibiotics and supportive therapy. While hospitalized, he suffered occasional bouts of cyanosis and dyspnea. In one attack, which occurred while the patient was having a bowel movement, he experienced severe substemal pain, became extremely pale, dyspneic, and died. Autopsy findings revealed a fibroma of the left atrium of the heart.

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(1) First Army Area Medical Laboratory, New York, N. Y.
(2) Ford, R.: Medicolegal investigation of violent and unexplained deaths. J. A. M. A. 145: 1027-1030, Apr. 7, 1951.

The second patient was a 22-year-old white man who had been in the Army 3 weeks. Throughout this time he complained of constant, sharp epigastric pain, nausea, and vomiting which occurred usually after meals. He was admitted to the hospital with a temperature of 99° F. On physical examination, the liver was greatly enlarged and tender. The impression at the time of admission was acute infectious hepatitis with jaundice. Later, roentgenograms of the lungs revealed lesions which suggested a metastatic carcinoma. At autopsy, a chorio-epithelioma widely disseminated throughout the body was found.

The third patient was a 46-year-old man who reported to the out-patient clinic 13 days prior to his death, complaining of headache, vomiting, vertigo, and insomnia of about 4 months' duration. He appeared to be somewhat lethargic and disoriented and had a slight paralysis of the left side of the face. Impression at that time was migraine headache or possibly encephalitis. He was hospitalized for 10 days, during which time he was given codeine and acetylsalicylic acid, small doses of meperidine hydrochloride, and small doses of seconal. The discharge diagnosis was histamine headaches. At the time of discharge he still complained of severe headaches and occasional vomiting and was given twenty-three 1 mg. capsules of cafergone to take with him. He returned 2 days later for more of these capsules but was given a placebo instead. On the following day he fainted in his barracks and was brought unscious to the hospital. He was pale but not cyanotic, with a pulse of 64 and a blood pressure of 140/78. Other than marked carpopedal spasm bilaterally, the physical examination was negative. Two hours after entering the hospital, he suddenly showed signs of acute respiratory distress and died 45 minutes after the onset of this attack. Autopsy revealed a glioblastoma multiforme of the right frontal lobe.

Six of the 8 cases of death caused by disease in the respiratory system were found to have histopathologic changes compatible with influenzal pneumonia. Unfortunately, viral studies were not performed on any of these patients. Three of them are of great interest and emphasize the possible virulence of influenzal pneumonia.

One patient, a 23-year-old Negro, entered the dispensary complaining of back pains. He associated this complaint with some heavy lifting he had done on the previous day. He had no fever and physical examination revealed no abnormalities. A roentgenogram of the lumbar spine was taken but the patient was discharged pending its evaluation. He was found dead in his bunk on the following morning. Autopsy revealed a hemorrhagic bronchopneumonia, probably of viral origin.

The second patient, a 20-year-old man, entered the hospital complaining of cough and hemoptysis of 1 week's duration. On admission, he was found to have a temperature of 104.6° F. Bubbling rales were heard in both lungs. He was placed on antibiotic therapy but died 5 hours after admission. The autopsy again suggested a viral pneumonitis.

The third patient was a 19-year-old Negro who was in an automobile accident while on furlough. He sustained no apparent injuries. Thirty-six hours after the accident he suddenly became ill and died shortly thereafter. A complete autopsy failed to reveal any signs of injury. The only positive findings were extreme congestion of both lungs which was most marked in the upper and middle lobes of the right lung and the entire left lung. The cytologic changes were compatible with a viral pneumonitis.

Eleven cases of death caused by disease of the cardiovascular system were also included in the study. Four of these involved men whose ages ranged between 23 and 35 years. In three, death was caused by coronary occlusion.

In one case autopsy findings served to exonerate an innocent man. A 29-year-old soldier who had engaged in a fist fight with a recruit was found dead several hours afterward in a bivouac area. At autopsy no evidence of trauma was found but the anterior descending branch of the left coronary artery was completely occluded by an atheromatous plaque.

Another patient was a 23-year-old West Point cadet with a cough of progressive severity present since he was 12 years old. He had gradually produced more and more sputum until shortly prior to his death, at which time he was producing about 60 cc. per day. He was frequently hospitalized at West Point for upper respiratory infections. Various diagnoses, including chronic bronchitis and bronchiectasis were considered although radiographic and bronchoscopic studies failed to reveal any significant changes. While playing handball he suddenly died. At autopsy the heart was found to be greatly hypertrophied and dilated. The myocardium was heavily infiltrated by epicardial fat. This case is similar to those described by Saphir and Corrigan (3) in which they found that extensive replacement of muscle fibers by fat was the only lesion present to account for the sudden death.

Brain damage and/or damage to the lungs and liver accounted for a large majority of the fatal injuries sustained in motor vehicle accidents. In 5 cases (25 percent) blood alcohol levels were found elevated above 1.5 mg. per ml. (4). Suicide was accomplished by carbon monoxide poisoning, self-inflicted gunshot wounds, jumping from high places, and ingesting bichloride of mercury. The first two methods mentioned far outnumbered the last two.

In 9 patients, the exact cause of death was not ascertained even after autopsy. These serve to re-emphasize the importance of obtaining a complete clinical history and performing thorough gross and microscopic

(3) Saphir, O., and Corrigan, M.: Fatty infiltration of myocardium. Arch. Int. Med. 52: 410-428, Sept. 1933.

(4) Spain, D. M.; Bradess, V. A.; and Eggston, A. A.: Alcohol and violent death; a 1-year study of consecutive cases in a representative community. (Clinical Notes Section.) J. A. M. A. 146: 334-335, May 26, 1951.

examinations as well as a toxicologic investigation. One such patient, an obese 39-year-old Negro, had been hospitalized because of possible diabetes. Laboratory findings confirmed the clinical impression. While hospitalized, he was placed on a diet and subsequently lost 10 pounds. On the day prior to his death his fasting blood sugar was 127 mg. per 100 cc. He left the ward without permission and was found dead in the back seat of his car. At autopsy no significant anatomic changes could be found to account for his death. The pathologist requested (1) a blood sugar determination from cardiac blood, (2) a blood alcohol determination, (3) carbon dioxide combining power, (4) blood cholesterol, and (5) tests to rule out volatile and metallic poisons. The cardiac blood sugar was 207 per 100 cc., the CO_2 combining power was 85.1 volume per 100 c., and the blood alcohol was 2 mg. per 100 cc.

In this patient carbon monoxide poisoning was certainly a possibility but the pathologist failed to request a carbon monoxide determination. The blood sugar determination on the cardiac blood was undoubtedly misleading. The increase of glucose in the blood of the right side of the heart because of glycolysis in the liver as well as the increase of glucose in the blood of the left side of the heart because of myocardial glycogenolysis (5) were not considered. We have frequently compared blood sugar determinations from the right and left side of the heart in accident cases and usually the determinations from the right side of the heart ranged between 250 and 350 mg. per 100 cc. The carbon dioxide combining power of 85.1 volume per 100 cc. was of no significance. It would be helpful in this type of case to obtain about 15 cc. of cerebrospinal fluid by cisternal puncture, in view of the fact that most postmortem chemical determinations are more reliable when spinal fluid is used.

In all cases it is advisable to obtain stomach contents, spinal fluid, blood, urine, and tissues from the brain, liver, kidney, and intestine for toxicologic studies.

In other cases the cause was not ascertained because of an incomplete gross and microscopic examination. For example, a 23-year-old man was admitted to the hospital complaining of difficulty in starting urination, accompanied by an intermittent flow. While hospitalized, he suddenly went into shock and died. The pathologist rendered a report of pulmonary edema and tubular degeneration of the adrenals. The central nervous system was completely disregarded as a possible site for the primary cause of death.

Failure to determine exact causes of sudden or unexplained deaths because of inadequate autopsy and/or toxicologic examinations should not be tolerated.

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(5) Naumann, H. N.: Studies on postmortem chemistry. Am. J. Clin. Path. 20: 314-323, Apr. 1950.

SUMMARY

In 15 percent of 59 cases of violent or clinically unexplained death, investigation, autopsy, and toxicologic examinations failed to disclose a definite cause of death. This emphasizes the importance of obtaining a complete clinical history and of performing thorough gross, microscopic, bacteriologic, chemical, and toxicologic examinations in all cases of sudden or clinically unexplained deaths.

Demountable Tidal Drainage Apparatus[1]

John F. Carney, *Major, MC, U. S. A.*
Quinton Lindsey, *Sergeant, Medical Service, U. S. A.*
Lowrain E. McCrea, *M. D.* (2)

THE value of tidal drainage in the management of the neurogenic bladder is well recognized. The purpose of tidal drainage is not only repeated irrigation of the bladder but also passive exercise to the neurogenically impaired detrusor urinae muscle. The use of such equipment would undoubtedly be more general if the usually available apparatus were not so complex, inefficient, costly, fragile, and at times difficult to procure when most needed. It is the purpose of this article to describe a tidal drainage apparatus that is simple in design, of low cost, efficient in action, immediately procurable, and easily assembled in any military or civilian hospital.

This equipment was conceived and designed as a unit using standard items listed in the Armed Services Catalog of Medical Material. The underlying principle is siphonage. In the use of some available types of tidal drainage apparatus much sediment collects in the bottom of the apparatus, particularly if the patient has an infection in the bladder. The sediment may flow from the apparatus into the bladder or from the bladder into the apparatus depending on the direction of flow of the irrigating fluid. For these reasons a more efficient tidal drainage apparatus seemed desirable. The apparatus here described eliminates that disadvantage.

It uses a test tube (Item 04435250) that measures 25 by 150 mm. as the reservoir. The siphon equipment consists of a glass tube (Item 4457750) measuring 6 mm. in diameter and 17.5 cm. in length, the distal end being tapered or notched. This tube is capped by a test tube (Item 0443385) measuring 13 by 20 mm. The base of the apparatus is a size 5 rubber stopper having two openings (Item 04420000). A small connecting tube bent under heat to a 90 degree angle completes the apparatus. The assembly of the equipment may be seen in figure 1.

(1) Valley Forge Army Hospital, Phoenixville, Pa.
(2) Civilian Consultant in Urology.

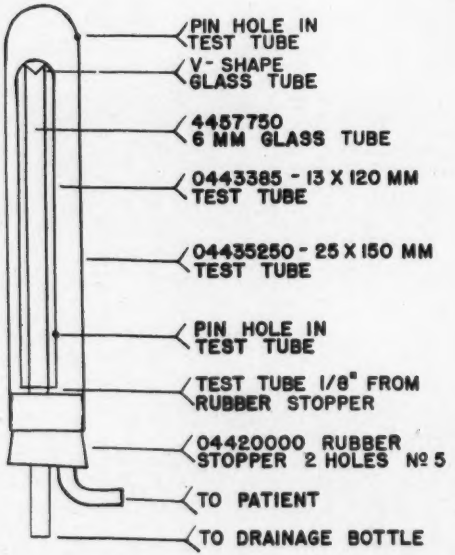
PIN HOLE IN TEST TUBE
V- SHAPE GLASS TUBE
4457750 6 MM GLASS TUBE
0443385 - 13 X 120 MM TEST TUBE
04435250 - 25 X 150 MM TEST TUBE
PIN HOLE IN TEST TUBE
TEST TUBE 1/8" FROM RUBBER STOPPER
04420000 RUBBER STOPPER 2 HOLES Nº 5
TO PATIENT
TO DRAINAGE BOTTLE

Figure 1. Schematic drawing of Lindsey tidal drainage apparatus.

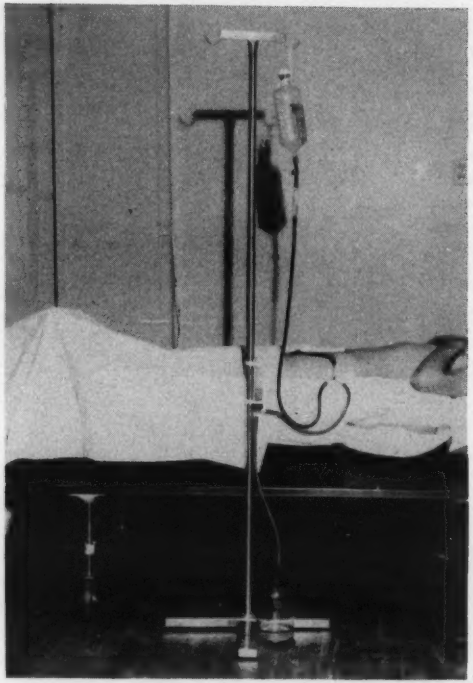

Figure 2. Lindsey tidal drainage apparatus in use.

A small hole is bored in the large test tube about 1.5 cm. from the base in order to maintain atmospheric pressure. A hole is also bored in the inner test tube 2.5 cm. from the mouth to break the siphon action, and prevent the suction of the bladder into the catheter. The inner test tube in the assembly is supported by the siphon tube at such a level that the mouth of the test tube is about 1/8 inch above the rubber stopper. The right angle tube is inserted in the rubber stopper at such a level that it is flush with the inner surface of the stopper.

If the bladder is found to be spastic by cystometric reading the tidal equipment must be elevated to prevent constant tripping. It is connected by a glass Y tube to the indwelling catheter worn by the patient. The base of the Y tube is inserted into the catheter (fig. 2). One arm of the Y tube is connected to the irrigating container. Intravenous fluid containers may be used. The other arm of the Y tube is connected to the right angle tube of the tidal drainage apparatus. The siphon tube projects from the rubber stopper for a distance of 2.5 cm. and is connected by rubber tubing to a waste receptable, preferably of 4,000 cc. capacity. This equipment is efficient and superior to other available apparatus. The bladder is completely evacuated before the tidal reservoir is emptied. The height of the fluid in the tidal reservoir is governed by the intracystic pressure as the bladder is filled, the bladder being filled primarily and the tidal reservoir being filled secondarily. This equipment is readily demountable for cleaning and for replacing broken parts, whereas the more elaborate commercial apparatus is a fixed unit which does not permit dismantling for easy cleaning. Furthermore, if any portion of the commercial equipment is broken the entire apparatus must be discarded.

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Repair of the Flexor Pollicis Longus Tendon

Francis H. McCullough, Jr., *Lieutenant, MC, U. S. N.* (1)

TO GRASP an object, one must press the distal joint of the thumb firmly against it and at the same moment apply counter pressure with a finger or fingers. The inability to perform this function is very disabling, particularly if the disability occurs in the dominant hand. Without the distal phalanx, the thumb is too short for a good grasp. If only the long flexor tendon is cut or avulsed, no pressure can be exerted in grasping although the thumb may be in a position to act, and objects cannot be held firmly. Function can be restored either by a repair of the long flexor tendon or by a stabilizing procedure on the distal joint, thereby enabling the short flexor tendon to exert its force through the bone.

CASE REPORT

A 20-year-old right-handed marine was wounded by an exploding mortar shell in Korea in December 1950. Metal fragments struck his right hand causing a compound fracture of the shaft of the middle phalanx of his middle finger and a compound chip fracture on the palmar surface of the distal phalanx of his thumb at the interphalangeal joint. There was no artery or nerve involvement. He was unable to flex the distal joint of his thumb. He received penicillin for a minor infection in his middle finger and following his hospitalization the wounds healed as did the fracture of the middle finger. He was discharged from the hospital to duty although he was unable to flex the distal joint of his thumb and was unable to grasp and hold objects. Examination in February 1951 showed that he was able to initiate motion of the flexor pollicis longus tendon and that the bone chip was movable. The tendon motion was noted on the proximal side of the interphalangeal joint in the crease of the thumb. There was a full range of passive motion in the distal joint. The extensor tendon was normal as was the remainder of the thumb and hand.

It was believed that this patient's hand could be benefited by replacing the flexor pollicis longus tendon to the distal phalanx of the

(1) First Provisional Casual Company, Fleet Marine Force, Pacific.

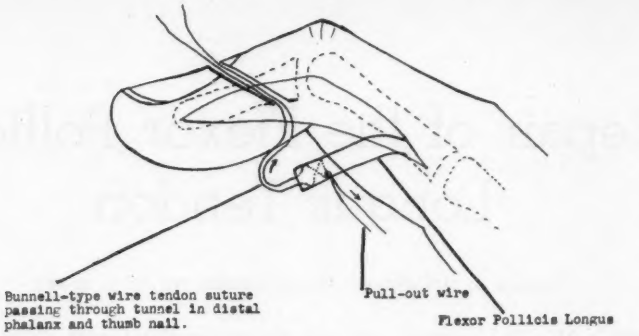
Bunnell-type wire tendon suture passing through tunnel in distal phalanx and thumb nail.
Pull-out wire
Flexor Pollicis Longus

Figure 1.

thumb. An operation was performed on 16 February using brachial block anesthesia. An anterolateral incision was made on either side of distal joint avoiding the joint crease. The joint capsule was opened laterally and the bone chip was found to be attached to the tendon sheath by a fibrous band of scar tissue on the proximal side of the joint capsule, accounting for the retraction of the tendon. The chip was grasped with an Allis clamp, the attached fibrous band was severed and the tendon was stretched. The chip was then excised from the end of the tendon. A 0.009 wire suture was placed through the tendon with a

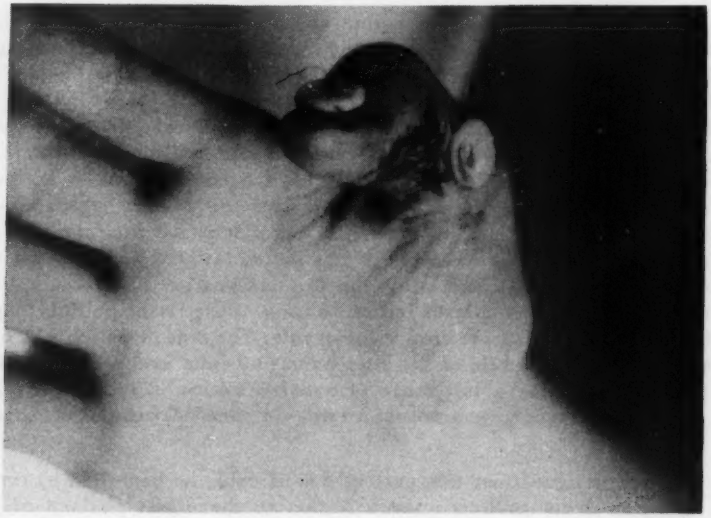

Figure 2. Three weeks after operation. Note the position of the buttons. The tendon is holding the distal phalanx in flexion.

pull-out wire employing the Bunnell technic. With a No. 9 dental bur in a bone drill, a tunnel was made obliquely through the fingernail and the proximal one-third of the distal phalanx. Through this the suture on the tendon was passed (fig. 1). The tendon of the flexor pollicis longus

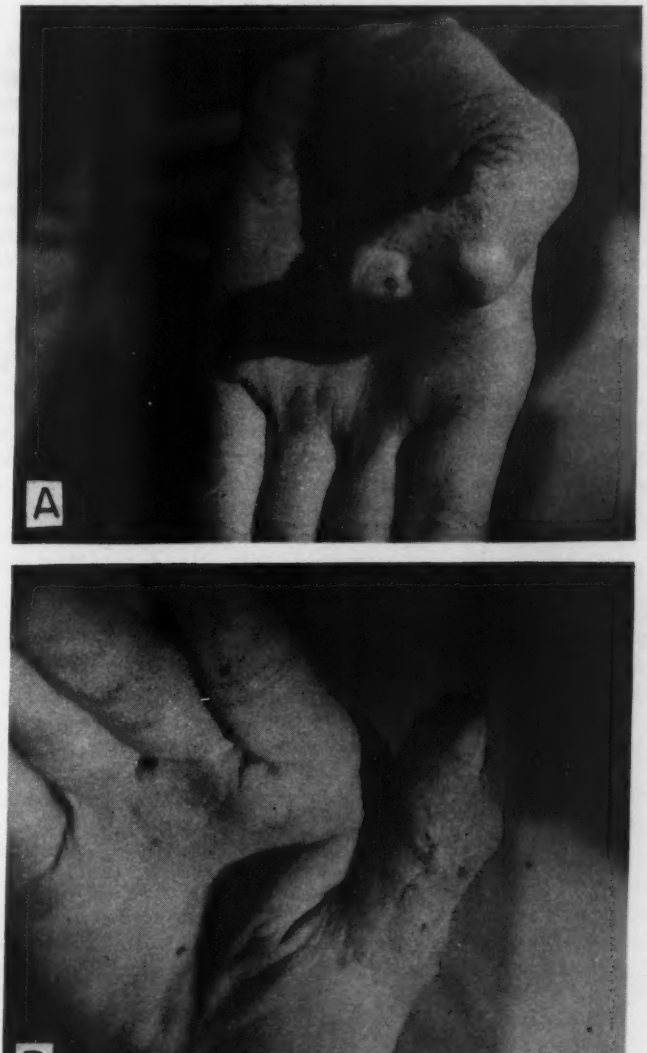

Figure 3. Degrees of (A) *active flexion and* (B) *extension obtainable 4 weeks after operation.*

muscle was then pulled snugly into the bone tunnel and secured by anchoring the tendon to a button on the nail. The pull-out wire was secured by another button proximal to the incision. The joint capsule was left open after noting that the patient could initiate motion of the distal joint and that the tendon glided smoothly in the exposed sheath and capsule.

The skin was closed with interrupted wire sutures. A plaster cast was applied from below the elbow, immobilizing the thumb in opposition with the distal joint flexed. The cast and sutures were removed 3 weeks later (fig. 2). The distal joint could be extended from its flexed position only a few degrees. The patient was instructed to start passive extension exercises slowly, being careful not to exert too much tension while extending the joint. Four days following the removal of the cast, the buttons and all internal fixation were removed by means of the pull-out wire. Four weeks after operation the patient was able to extend the distal joint of his thumb to 165° and flex it to 90° (fig. 3). He was not given any formal physiotherapy treatment, but was instructed in passive and active motion to the tolerance of pain to gain full extension of the joint. The fifth week after operation he was grasping a rubber ball and pressing the ball with the thumb, gradually increasing the amount of pressure by the long flexor tendon.

Six weeks after operation the distal joint of his thumb showed a full range of motion. He was able to grasp objects and hold them.

An Unusual Cause of Negative Radiologic Shadows in the Stomach

Allan B. Ramsay, *Colonel, MC, U. S. A.* (1)

Henry Thompson, Jr., *Major, MC, U. S. A.* (1)

ON RADIOLOGIC examination of the stomach a negative shadow may be observed through the barium as a result of many types of space-occupying masses or objects. The phenomenon may be observed as a result of carcinoma, leiomyoma, lymphoma, sarcoma, polyp, aberrant pancreas, bezoar, enlarged gastric rugas and adjacent extrinsic lesions. All of these conditions have been discussed many times in the literature. Recently we have observed on a gastrointestinal series negative shadows produced by a surgical procedure for the closure of a perforated gastric ulcer consisting of plication of the stomach wall over the site of the rupture.

CASE REPORT

A 30-year-old man was admitted to this hospital on 26 December 1950 with acute abdominal pain. He gave a history of gastric distress and dyspepsia which had appeared at intervals during the preceding 4 years. On 2 occasions he had had hematemesis. His distress was precipitated by eating foods usually not tolerated by patients with peptic ulcer. His symptoms were relieved by drinking milk. At 0300 hours on the date of admission he was seized with a sudden, sharp, stabbing pain in the epigastrium and other clinical findings of a perforated peptic ulcer.

At operation a perforation 3 mm. in diameter was found in the anterior wall of the gastric antrum. This was surrounded by an area of induration about 5 cm. in diameter. The ruptured ulcer was closed with a single "00" chromic catgut purse-string suture and reinforced by four interrupted sutures of the same material. The stomach wall was then

(1) Army and Navy General Hospital, Hot Springs National Park, Ark.

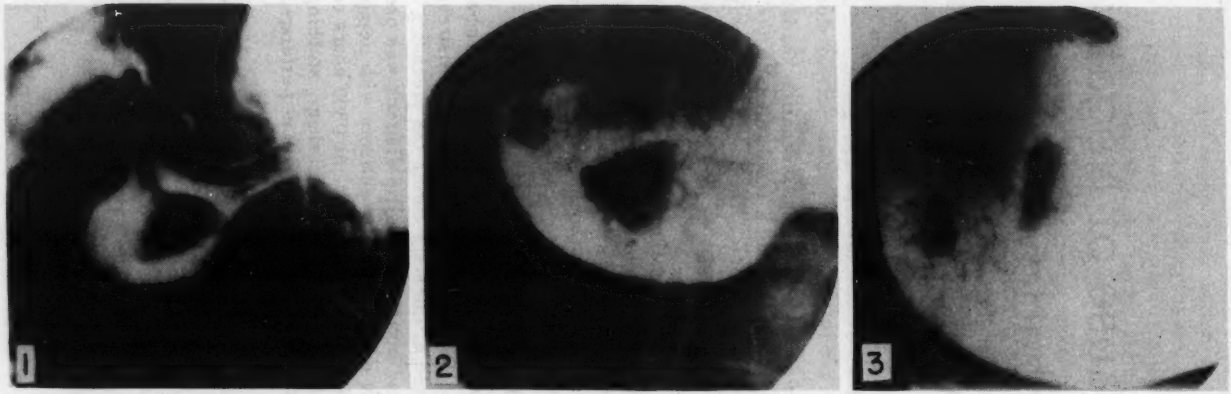

Figure 1. Roentgenogram showing a triangular configuration of the negative shadow during antral systole. Figure 2. Roentgenograms showing two negative shadows. The larger is roughly triangular in shape, the smaller is oval. Figure 3. Pressure technic during the diastolic phase demonstrates three shadows in this roentgenogram varying from a round to an oval contour.

plicated over the site with "0000" black silk sutures. The surgeon further satisfied himself by securing a tab of omentum over the site of the rupture. The postoperative course was uneventful but, because of the history of hemorrhage and the recent perforation, the patient was advised to return to the hospital after 30 days for a subtotal gastric resection.

In compliance with the advice of his surgeon the patient returned. Preparation for the operation included a gastrointestinal series which was repeated because of the bizarre findings. On each examination from one to three negative shadows were observed in the antrum of the barium-filled stomach. The number of these shadows depended somewhat on the phase of peristalsis. During extreme systole only one shadow could be observed (fig. 1); with less vigorous contraction two (fig. 2); and in diastole three could be seen (fig. 3). In addition, the contour of the most persistent shadow changed from a rectangular configuration to a triangular one, and finally to one more oval in shape. The radiologist was somewhat bewildered by these changes. To paraphrase an old bromide, the stomach appeared to be 'quicker than the eye."

At the second operation the previously described black silk sutures were all intact and the anterior wall of the antrum presented its plicated appearance. Unfortunately no photograph was made and the sutures were released in order to accomplish the partial gastric resection. On examination of the operative specimen it was found that the ulcer had healed with residual scarring barely perceptible to the naked eye. The gastric mucosa showed no hypertrophy of the rugas and there was no evidence of tumefaction. It was immediately apparent to all that the bizarre radiologic findings were produced by the gastric wall folded into the plication.

DISCUSSION

Radiologists and surgeons are always keenly interested in negative shadows seen through a viscus containing barium when these shadows are not produced by normal mucosa. The constancy of shadows is a criterion not to be passed over lightly. In this case only one shadow was constantly present and the configuration of this shadow changed under fluoroscopic and spot film observation. Perhaps we should have realized preoperatively that our "tumors" were surgeon made. Actually this was considered but not seriously.

The dynamics of the observed phenomena can be explained if one considers the functions of the muscle layers and the mucosa of the stomach. Golden *(2)* tells us from his experimental work on dogs that antral systole is associated with a contraction of the longitudinal

(2) Golden, R.: Roentgen-Ray Examination of the Digestive Tract. (Reprinted from Nelson's Loose-Leaf Diagnostic Roentgenology.) Thomas Nelson & Sons, New York, N. Y., 1949. p. 296.

muscle toward the pylorus. He further quotes Schindler who, from gastroscopic observation, describes a shortening of the antrum with peristalsis. The mucosal folds of the antrum, which during relaxation run transversely across the stomach, shift to the long axis when systole occurs. The muscularis normally is freely movable and shifts cephalad when the longitudinal muscle layer contracts. Redundancy of the mucosa in the antrum is thus prevented during the systolic phase. In our patient it is believed these normal movements were impeded by the sutures and in the case of the most persistent shadow observed, at the site of the perforation of the ulcer, this fixation of the layers contributed to the formation of a mass of tissue. The multiple shadows, seen during the diastolic phase, using pressure technic, are caused entirely by the plication of the gastric wall causing the mucosa and muscle layers to project or bulge into the lumen, The report of this case may save other radiologists and surgeons from similar confusion.

A Method of Sterilizing and Maintaining the Dental Handpiece

Jerome B. Casey, *Commander, DC, U. S. N.* (1)

USUALLY, particularly in the Tropics, the procedures that suffice to sterilize and maintain dental instruments invite rust, excessive wear, and excessive vibration, if not actual stoppage, of the dental handpiece. Therefore, the handpiece should be cleaned and oiled daily and wiped with one of the approved solutions between patients. Running the handpiece in an oil-antiseptic mixture and, as most recently advocated, placing it in a small container flooded with ultraviolet light are also recommended.

Efforts simultaneously to clean, sterilize, and lubricate the handpiece, using hot oil in whole or in part, in various simple and complicated technics have been advocated by Rehrauer, Parke, and others. The Council on Dental Therapeutics of the American Dental Association stated in "Accepted Dental Remedies" that experiments in which *Bacillus anthracis* was used as the test organism indicate that immersing the handpiece in light liquid petrolatum at 185° C. for 5 minutes will disinfect it. There is, however, a fire hazard involved in using the old type of sterilizer intended for use with water only because its heating coils are capable of taking the oil above its flash point. For this reason there was a service directive several years ago that only sterilizers especially designed for oil were to be used with oil.

Because of the great number of water sterilizers on hand, the cutback in military appropriations, and, more recently, impending shortages caused by the Korean war, the oil sterilizers have been and are slow in coming and, will be almost unobtainable for some time to come. The simplest method of oil sterilization at the chair, namely placing the handpiece in the upper right spray bottle container up to the wristpiece and turning the control on full heat, with light liquid petrolatum

(1) Naval Station, Roosevelt Roads, Puerto Rico.

in the container, is an effective way of maintaining the handpiece under tropical conditions. This method probably was first used early in World War II in an Army installation in the Tropics.

The company manufacturing the standard operating unit used by the Navy was asked whether the oil would ignite if the rheostat lever of the spray bottle heater were left on 5 (maximal heat) for a prolonged time. It was found that "it would be all right to use mineral oil in the spray bottles, because our spray warmer with the control set at 5 only goes up to about 200° F. * * * and stays at about 200° F., without injury to the unit." We checked this and found that the temperature of the oil was consistently below 230° F. in the spray bottle. The usual temperature after the unit had been on for 45 minutes was between 220 and 230° F. When the oil was used in the metal container without an intervening bottle and air space, the temperature of the oil rose to between 230 and 240° F., but did not rise higher. In other words, no thermostat was involved and none was needed because the coil did not heat the container above 240° F. (more than 150° F. below the flash point of even light oil).

It was convenient to keep one handpiece at a time in the heater, one on the cabinet, and one on the wristpiece, rotating their use so that during a full operative appointment one handpiece was cooling and draining as one was being used and the third was being sterilized for at least 10 and usually over 30 minutes. Thus a safe sterilization time is assured without the necessity for prompt removal in order to avoid rusting. Furthermore the long immersion time is effective in cleaning the handpiece without the use of highly volatile substances. Although the oil could be used directly in the metal container, which would allow several handpieces to be placed in the oil at the same time, (1) convenience in emptying and cleaning the receptable, (2) the fact that the oil would rise higher on the handpiece placed in the intervening bottle, and (3) the appearance factor, all prompted the use of a wide-mouthed bottle placed in the metal container.

A Case of Hemophilia[1]

William M. Webb, *Lieutenant Colonel, MC, U. S. A.*

Manuel D. Altamirano, *First Lieutenant, MSC, U. S. A.*

THOSE cases of disease which follow the textbook picture present no diagnostic problem as long as they are kept in mind. Often, cases which we believe represent a definite diagnosis present certain discrepancies in the findings from a clinical or laboratory standpoint.

Robbins (2) reported a case of hemophilia which, in many respects, is similar to ours. In attempting to prove the diagnosis of hemophilia in our patient we could not, by following the procedure outlined by Quick (3), obtain the findings which we believed we should in regards to the prothrombin consumption time. Nevertheless, we made the diagnosis of hemophilia and separated the man from the service. On the basis of history alone, this man should not have been enlisted.

CASE REPORT

A 23-year-old soldier was admitted to this hospital on 15 January 1951 for evaluation and ultimate discharge from the service because he was a bleeder. He was rejected by the draft board in May 1945 because of his history but on 9 November 1950 he was enlisted. His father, age 62, was living and well with no history of abnormal bleeding. His mother, age 62, was living and had arthritis. The patient had two maternal uncles, one of whom died at age 26 and one at 31 from uncontrolled bleeding. Both uncles had bled frequently as children. The patient's maternal aunt had four children of whom one was a boy; he was not a bleeder. The patient has two brothers, both unmarried who are not bleeders and two sisters. Each of his sisters is married and has one son. Neither nephew is a bleeder.

The patient was told that as a baby, whenever he fell and bumped his head, he would have a large swelling in that area. As a child, he was watched very carefully to prevent his cutting or injuring himself.

(1) U. S. Army Hospital, Fort Benning, Ga.

(2) Robbins, J. J.: Hemophilia; report of case. U. S. Nav. M. Bull. 49: 1115-1120, Nov.-Dec. 1949.

(3) Quick, A. J.: Management of hemophilia in general practice. J. A. M. A. 145: 4-8, Jan. 6, 1951.

When he was about 6 years old, he mashed his right great toe. It was necessary to keep him in bed for about 2 months at this time because the toe was quite swollen and oozed blood continuously for 11 days and nights. At various times there was bleeding into his ankles and right knee, following minor trauma. His right knee was swollen for years in childhood and he complained on admission that if he walked much it became enlarged but not painful.

In February 1947, he went to a local hospital to have some teeth pulled. Because of his history of abnormal bleeding he was hospitalized while having 10 teeth extracted. He remained in the hospital for 3 months and had 10 transfusions. He entered the hospital weighing 170 pounds and was discharged weighing 98 pounds. This information was substantiated by the local hospital. A letter from his family physician stated that many methods of controlling hemorrhage were used, but he had continued to ooze profusely from his gums. The family physician further stated that they were unable to make a diagnosis of the condition because bleeding and coagulation time were normal. About 1 year prior to admission the patient fell from a horse and bruised his right thigh. The thigh swelled to at least twice its normal size and became discolored. He was bedridden for 2 months at this time.

TABLE 1. *Prothrombin consumption time of normal control and patient compared with standard for diagnosis of hemophilia*

	Tube	Time after formation of solid clot (minutes)			
		15	30	45	60
		Prothrombin consumption time (seconds)			
Control	1	22	34	46	40
	2		28	47	40
	3			30	26
	4				40
Patient	1	7	25	27	30
	2		7	20	22
	3			9	17
	4				9
Standard (hemophiliac)	1	9	9	9	9
	2		8½	9	9
	3			9	9
	4				9

Physical examination revealed a tender fibrotic mass measuring 3 by 7 cm. in the lower half of the lateral aspect of the right thigh. This fibrotic mass was freely movable near the surface but seemed firmly attached to the underlying muscle. No ecchymoses were seen.

The Rumpel-Leede's sign was negative. A roentgenogram of the lower half right thigh was negative. The erythrocyte count, leukocyte count, and sedimentation rate were normal. The prothrombin time was 16 seconds (equivalent to 90 percent concentration). The platelet count was 340,000. The bleeding time was 2½ minutes; the clotting time (venous blood, slide method) was 18 minutes; the prothrombin consumption time was abnormal; and the clot retraction was complete after 4 hours.

The prothrombin consumption time was determined following Quick's method *(4)* using a normal individual simultaneously as a control (table 1).

DISCUSSION

In the case presented, results were obtained which do not correspond with the findings in a normal person, nor in a hemophiliac patient as reported by Quick. At the time the prothrombin consumption time was determined, the coagulation time of the patient's venous blood, using the slide method, was 18 minutes. The patient's prothrombin consumption time at 15 and 30 minutes after the solid clot formation was 7 seconds, whereas, in the normal control it was 22 and 28 seconds. In the serum of normal venous blood, sufficient thromboplastin remains to obtain a normal prothrombin time. In contradistinction, in the serum of our patient an excess of thromboplastin remained to produce a rapid prothrombin time. Although the case presented did not show the results that Quick found in his studies, the history and clinical findings were typical of hemophilia, and although the prothrombin consumption time did not confirm the diagnosis (if the criteria established by Quick are adhered to) it was not normal and did lend some support to the diagnosis of hemophilia. It would appear that there was some deficiency of thromboplastin in our patient.

(4) Quick, A. J.: Coagulation mechanism with specific reference to interpretation of prothrombin time and consideration of prothrombin consumption time. Am. J. Clin. Path. 19: 1016-1023, Nov. 1949.